The Consequences and Treatment of Alimentary Toxæmia from a Surgical Point of View.

By W. Arbuthnot Lane, M.S.

In order to consider the subject of chronic intestinal stasis in any detailed manner, it will be best to deal with it from its very beginning, and I shall commence by reminding you of several most important general laws which I formulated many years ago with regard to the

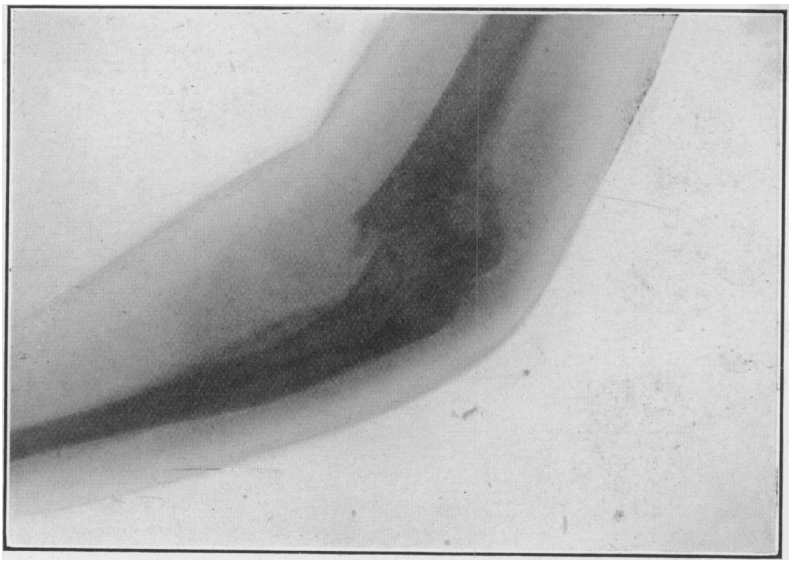


Fig. 1.

skeleton and its articulations. I shall then proceed to demonstrate that precisely the same laws govern the soft parts and modify their structures, and that a knowledge of the several mechanical conditions which bring about chronic intestinal stasis is largely dependent on a recognition of these fundamental principles.

The skeleton represents the crystallization of lines of force which when exerted in a single direction are laid down as compact tissue; when in varying directions as cancellous. In young life any alteration in the length of a long bone following on a fracture in which the fragments have not been replaced in accurate apposition results in the formation

of a new shaft and the absorption of the old one in a degree proportionate to the alteration in the form of the bone. This process takes place in a degree inversely proportionate to the age of the child. Later

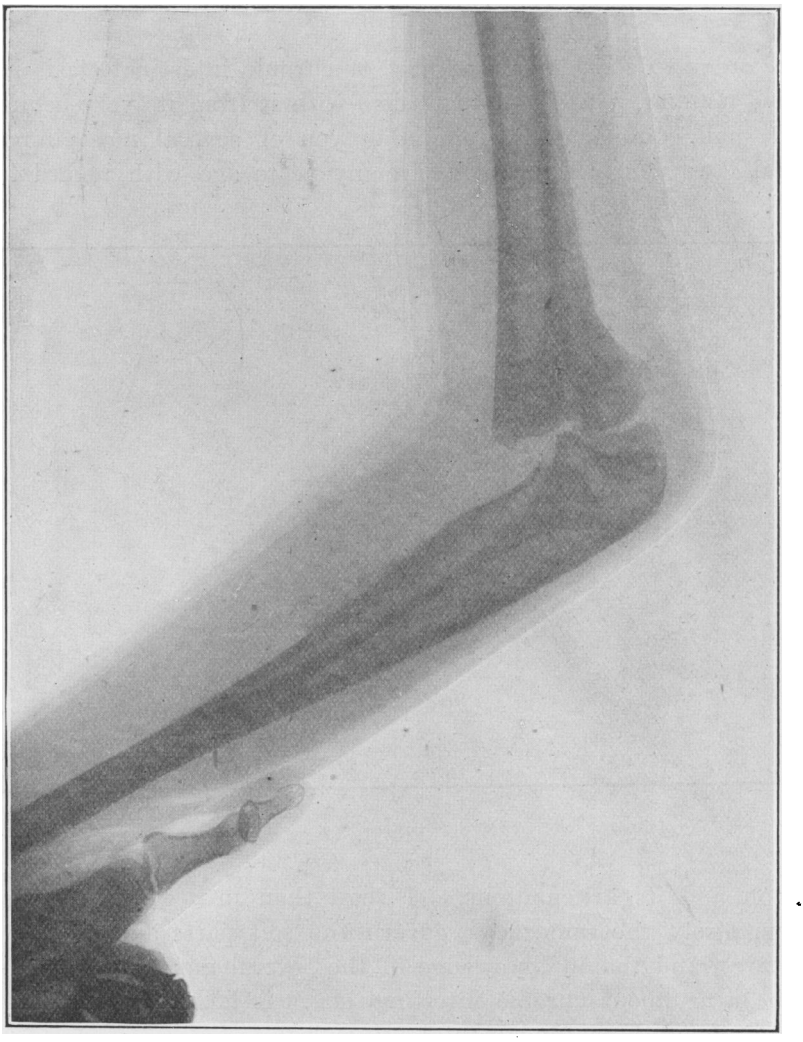


FIG. 2.

in life a lesser, but similar, change may be brought about by the artificial engorgement of the part with blood and much of the deformity and shortening which would otherwise occur can thus be obviated.

It follows as a complement to this latter law that "the rates of bone formation in the several portions of a growing line vary inversely as the pressure transmitted through them," and, incidentally, it is by the exercise of these mechanical principles that Nature reduces to a minimum the harm done by the incapacity of the surgeon in the treatment

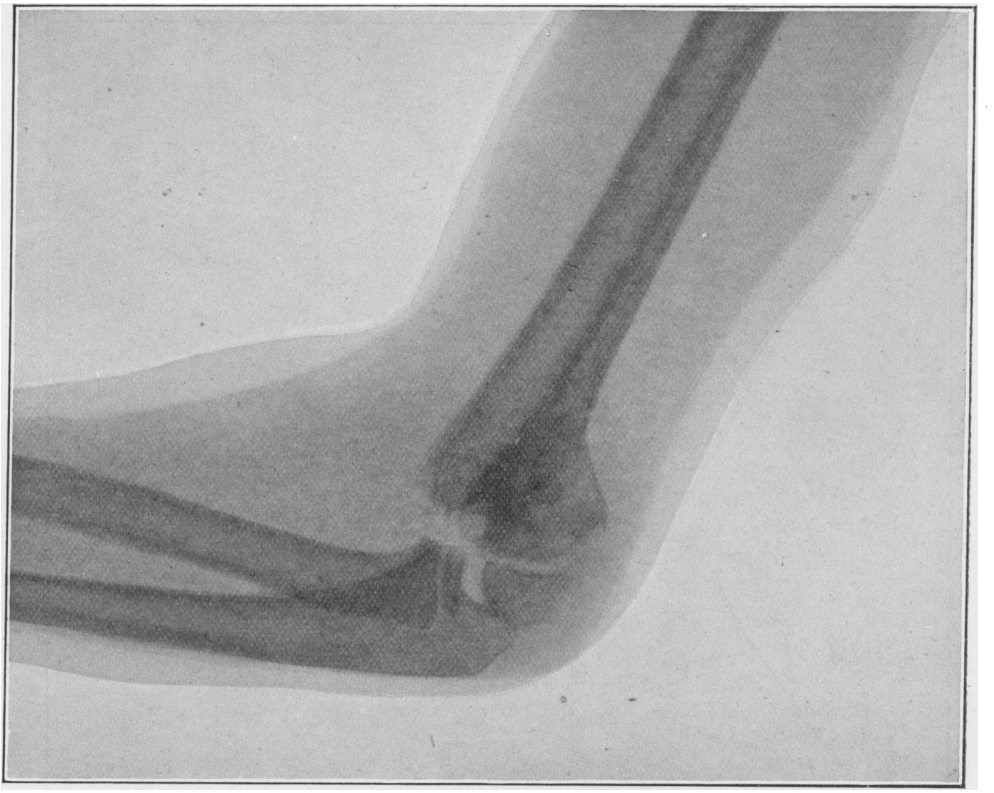


FIG. 3.

of fractures in young life. The accompanying skiagrams illustrate the action of these laws:—

Fig. 1 represents a fracture about the lower epiphysis of the humerus with backward displacement of the fragment. Six weeks had elapsed since the injury. A dark zone extending vertically upwards from the epiphysis behind the shaft indicates the commencement of the crystallization of the lines of force.

Fig. 2 represents the condition three months after the injury. The

perceptible layer of callus extends a greater distance up the back of the shaft. The shadow formed by it is much darker, equalling that produced by the original shaft.

Fig. 3 shows the part six months after the injury. The range of flexion has increased partly by the absorption of the end of the shaft and partly by that of the coronoid process. The layer of new material,

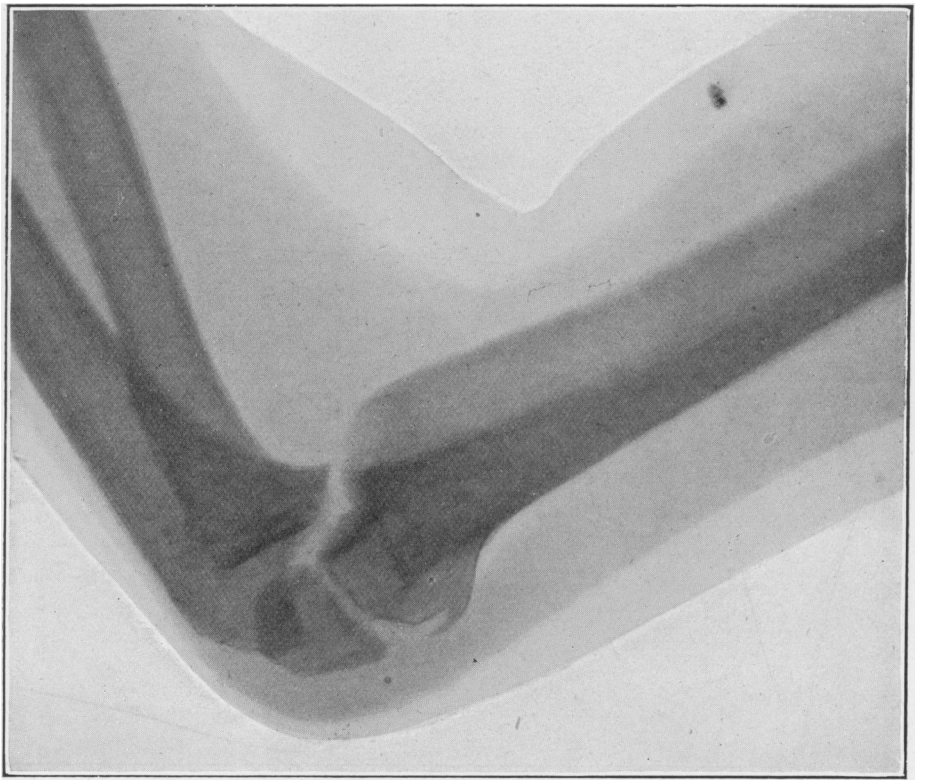


FIG. 4.

which is extending much farther up the shaft, is denser, while the shaft is relatively lighter.

Fig. 4, taken sixteen months after the fracture, shows that flexion is still further increased by progressive absorption, while the changes already noted in the original shaft and in the new formation are much more marked.

Fig. 5, taken three years after the injury, shows that a new shaft connecting the extremities of the bones has been laid down, while the

FIG. 5.

original one has almost completely disappeared. The range of flexion is still further increased.

On general principles we see that the necessity or the importance of effecting a complete restoration of the form of the fractured bone varies directly with the age of the individual.

Again, by altering the mechanical relationship of the individual to his surroundings, a skeleton is produced which differs from the normal often to an extent greater than the normal does from that of the higher ape. A study of the development of such changes in the skeleton which clearly occur during the lifetime of the individual shows them to be governed by the three following laws:—

(1) That pressure produces changes in the structure and form of the bones and in the form and function of existing joints, while it determines the formation of new joints.

(2) That strain produces change in the form of the bones, and in the form and function of existing joints, and also produces new joints.

(3) That when, apart from the exercise of pressure or strain, it is important, from the altered mechanical relationship of the individual to his surroundings, that a mechanism should be modified or an entirely new one developed, such a change takes place.

The normal form of the skeleton and of the soft parts depends on a normal combination of attitudes of activity with attitudes of rest. If attitudes of rest are habitually affected these attitudes become fixed and then exaggerated. If, on the other hand, certain attitudes of activity are habitually affected these also become fixed and later exaggerated. In other words, while an attitude of rest or of activity is being assumed on a single occasion there exist certain tendencies to change. If these attitudes are assumed habitually then these changes become progressive actualities, the result of which is to produce such very definite alterations in the form of the skeleton that the life-history of the individual can be readily determined not only from the examination of the whole skeleton but frequently from that of a single bone.[1]

The space at my disposal renders it impossible for me to consider at any length the work on this subject which I did many years ago in the dissecting room, and which has served as a perfectly secure groundwork on which has been based what little surgical work I have since been able to do. I would, however, remind you of the anatomy of certain

[1] "The Causation, Pathology and Physiology of several of the Deformities which develop during Young Life," *Guy's Hosp. Reports* (1886) 1887, xliv, pp. 241-333; and "The Causation and Pathology of the so-called Disease, Rheumatoid Arthritis, and of Senile Changes," *Trans. Path. Soc.*, Lond., 1886, xxxvii, pp. 387-447.

labourers which afford excellent instances of the fixation and exaggeration of the tendencies to change which exist when a certain attitude is assumed habitually, and also of the fact that the same hold true of resting postures as illustrated by flat-foot, knock-knee, dorsal excurvation, lateral curvature, &c. I have much hesitation in inflicting these details upon you, but I am driven to do it as there exists still the same tendency on the part of many surgeons to consider any deviation from the normal as being congenital or inflammatory in origin. Just as pathologists used to regard all the evolutionary bone and joint changes of the labourer as being the result of a disease called osteo- or rheumatoid arthritis, so they now consider the acquired bands and mesenteries about the intestines as being congenital or inflammatory in origin, and employ such terms as pericolitis, mesosigmoiditis, &c., to indicate their causation. I fear it would be useless for me to attempt to alter the creeds of those who have possessed them for a long time, but I hope to induce the younger members of our profession to interest themselves in the mode of development of these evolutionary processes in the skeleton before arriving at a definite conclusion on the subject.

To show the changes that arise in the skeleton which are obviously evolutionary in the lifetime of the individual by the habitual assumption of an attitude or sequence of attitudes of activity, I am employing the following illustrations which have all been fully described in early papers. Here I must necessarily describe them very briefly. I do so with the distinct object of illustrating the three laws I have already referred to.

Fig. 6 represents portions of the spine and thorax of a brewer's drayman, and shows the fixation and exaggeration of the attitude of activity which is assumed when a heavy barrel is supported on the right shoulder. The alteration in form is occasioned by a change in the shape of the ribs, by the destruction of the fibro-cartilages and the bone at the seat of greatest pressure, and by the formation of thick osseous lips at the margins of the articular surfaces to increase the security and strength of the spine. In this manner an almost rigid shelf is formed on which the barrel can be supported and through which the weight can be transmitted with a minimum expenditure of muscular energy.

Figs. 7 and 8 represent the spine of a coal-heaver. They show much destruction of fibro-cartilages, and the fixation of the margins of the vertebræ one to another by dense lips of bone which practically render the lumbar spine immobile. In fig. 9 the last lumbar vertebra is displaced forwards, and is ankylosed to the sacrum, forming a variety of

spondylolisthesis. Contrast the conditions present here with those in fig. 10, where an arthrodial joint has been developed. This specimen

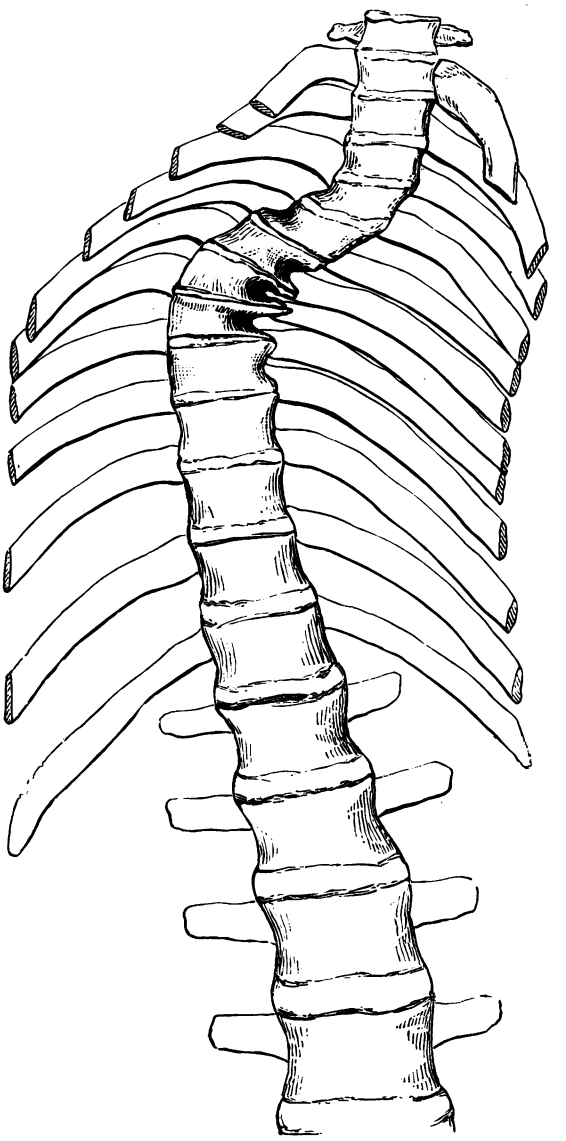


FIG. 6.

Spine and ribs of a brewer's drayman.

was obtained from the body of a labourer whose business it was to carry loads, lifting them from the ground and replacing them.

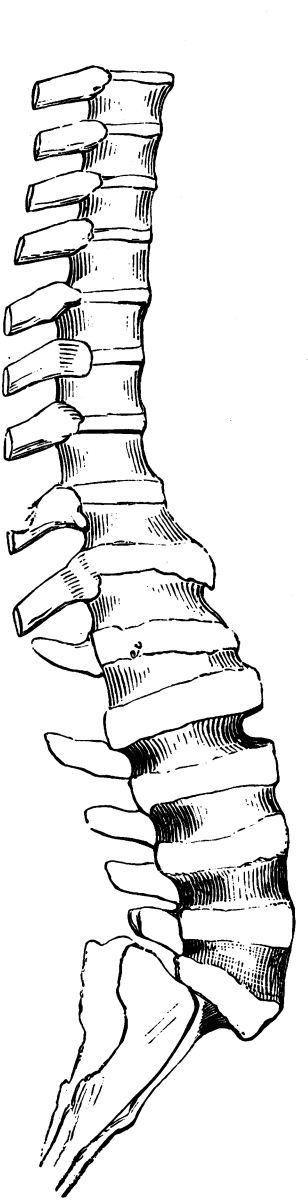


FIG. 7.

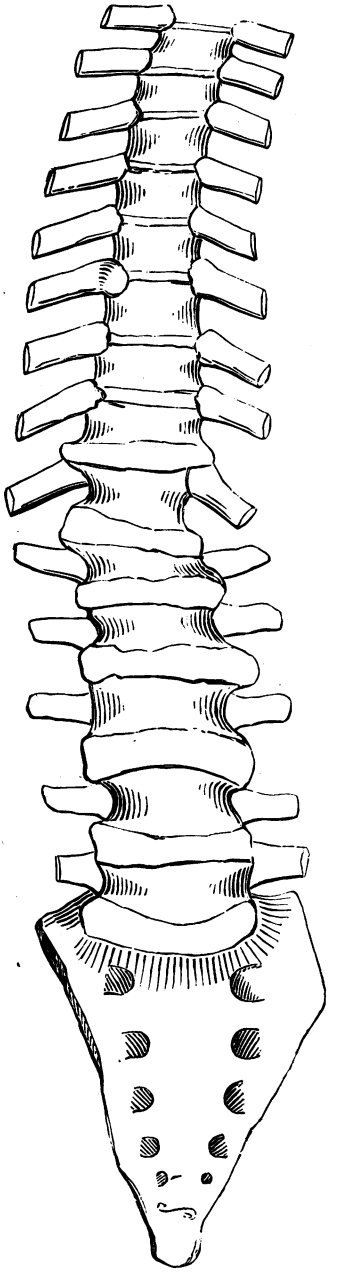


FIG. 8.

Fig. 7 shows a lateral view of a coal-heaver's spine, and fig. 8 an antero-posterior one.

In contrast with figs. 9 and 10, fig. 11 shows the condition of the lower part of the spinal column in a labourer who was habitually engaged

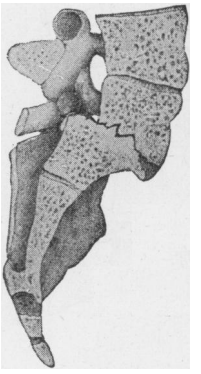


FIG. 9.

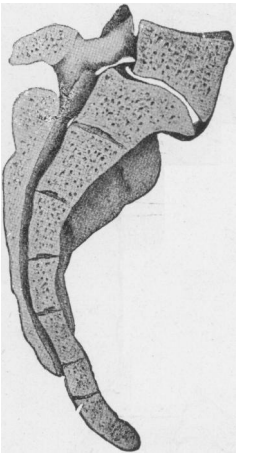


FIG. 10.

Fig. 9.—Fourth and fifth lumbar vertebræ and sacrum of coal-heaver.
Fig. 10.—Fifth lumbar vertebra and sacrum of deal-porter.

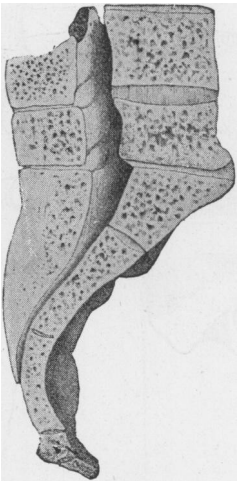


FIG. 11.

Fourth and fifth lumbar vertebræ and sacrum of labourer who carried loads in front of him.

in carrying loads in front of him. The constant over-extension of the spine resulted in a backward displacement of the fifth lumbar vertebra

on the sacrum, and an exaggerated development of the spines of the lumbar vertebræ and sacrum, which articulated with one another, transmitting a considerable proportion of the superjacent weight. This

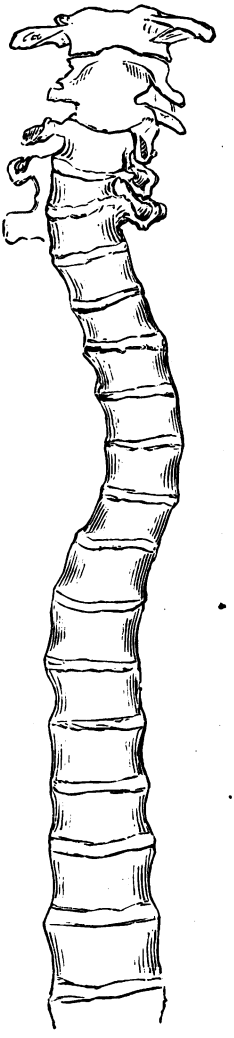


FIG. 12.

Spine of labourer who carried loads on his head.

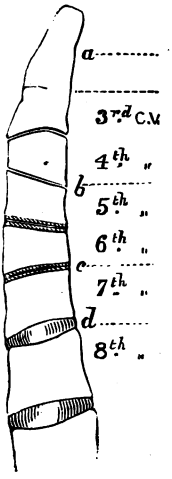


FIG. 13.

subject is dealt with in a paper published in the *Transactions of the Obstetrical Society*, 1887, xxiv, "The Mechanical Factors which determine the Form of the Pelvis in the two Sexes." The destruction of fibro-cartilage occurs as in all other laborious occupations.

Figs. 12 and 13 show the changes which result from habitually carrying heavy loads on the head. Fig. 13 is a vertical antero-posterior section of the same specimen. The lateral curves should be noted, serving presumably to render the column less rigid. The destruction of fibro-cartilage, the formation of arthrodial joints in the upper part of the cervical spine, and the ankylosis of the second and third cervical vertebræ, are also indicated.

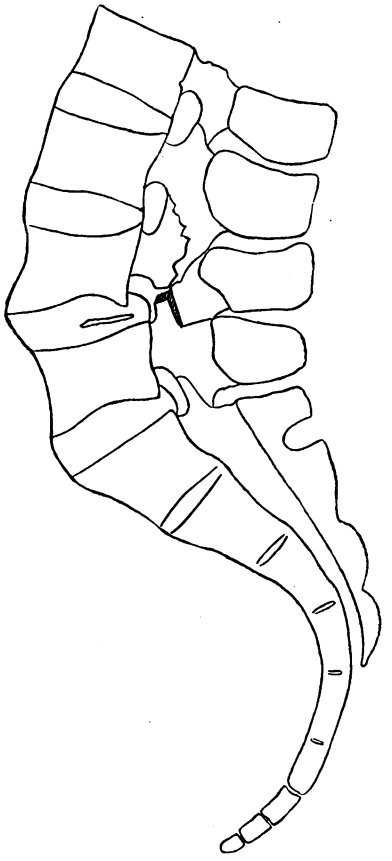


FIG. 14.

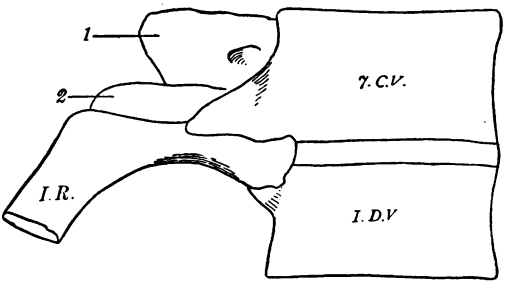


FIG. 15.

Fig. 14.—Lumbar vertebræ and sacrum of coal-trimmer.
Fig. 15.—Seventh cervical and first dorsal vertebræ of coal-trimmer.

Fig. 14 is a vertical median section through the lower part of the spinal column of a coal-trimmer.[1] It shows the formation of an arthrodial

[1] "A Remarkable Example of the manner in which Pressure Changes in the Skeleton may reveal the Labour History of the Individual," *Journ. of Anat. and Physiol.*, 1886-87, xxi, pp. 385-406.

joint in the fibro-cartilage between the fourth and fifth lumbar vertebræ, and the fourth arch divided at two points. This division is seen more clearly in fig. 16, and has resulted from the forcible rotation of the spine on a vertical axis which takes place when coal is thrown with great force to a considerable distance behind this labourer when engaged at his work. Fig. 15 represents the seventh cervical and first dorsal vertebræ with the first rib, and the arrangement by means of which the head of the first rib is secured so as to obtain a firm and powerful hinge-joint.

Figs. 17 and 18 illustrate the changes which develop in the right femur of the coal-trimmer in consequence of the special functions it performs: the area of impact of the neck of the femur locking and limiting the range of movement of the joint being shown very clearly.

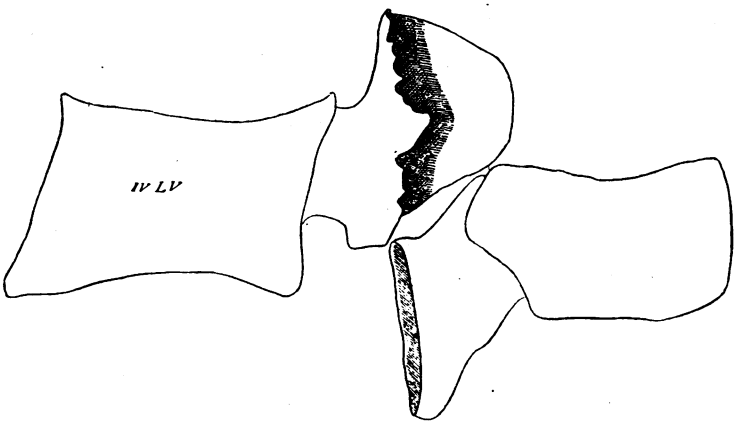


FIG. 16.
Fourth lumbar vertebra of coal-trimmer.

Fig. 19 shows the conversion of the first costal cartilage directly into bone under the influence of strain with the development of a new joint in the ossified cartilage; also the formation of a new joint between the clavicle and first costal arch, and of a similar arthrodial joint between the coracoid process and clavicle. All these evolutionary changes take place in the fully developed skeleton.

In fig. 20 the joint, probably arthrodial originally, has become amphi-arthrodial with very limited movement, while in fig. 21 the joint has been obliterated.

The second general law — namely, the influence of strain on the skeleton—is very well illustrated by figs. 22 and 23. They represent,

respectively, the scapula of a shoemaker and of a deal-porter, the latter having carried his load habitually on the right shoulder. Besides the pressure changes as shown by the character of the acromio-clavicular and shoulder-joints, fig. 22 shows the result of strain exerted chiefly on the trapezius and levator anguli scapulæ, and fig. 23 the very great breadth of the acromion process, which develops in consequence of the strain on the back of the deltoid, and the eversion of the margins of the supra-

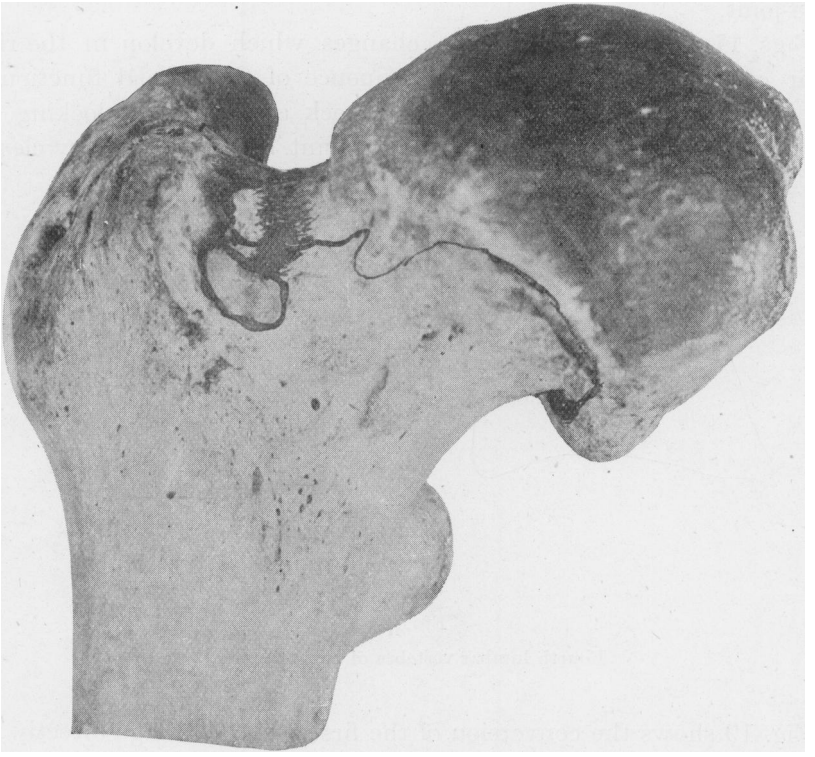


FIG. 17.

Anterior aspect of upper extremity of right femur of coal-trimmer.

spinous fossa from that sustained by the supraspinatus muscle. The strain on the infraspinatus and teres major muscles, and upon the rhomboids during the process of pulling the threads by the shoemaker, has left a very definite impress upon the bone.[1]

[1] "The Result produced upon the Muscles, Bones, and Ligaments by the Habitual Exercise of Excessive Strain," *Brit. Med. Journ.*, 1888, ii, p. 1205.

The third law, viz., "that a pre-existing mechanism may be modified or an entirely new one formed apart from the influence of pressure or strain," is well illustrated by a new joint which develops in the shoemaker. This structure is not present in the normal skeleton. During the jerk upon his thread, the head, which is held somewhat obliquely as regards an antero-posterior axis upon the spine, is rendered more secure by the formation of a buttress of bone, which extends upwards

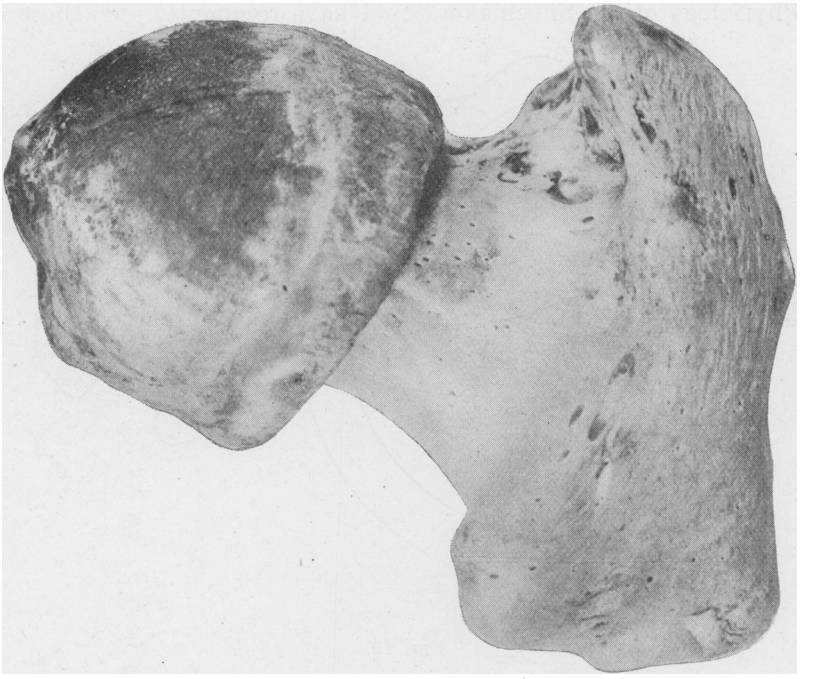


FIG. 18.

Posterior view of upper extremity of right femur of coal-trimmer.

from the lateral mass of the atlas on the one side and articulates, by means of an arthrodial joint, with the jugular process of the occipital bone. This is shown in fig. 24, which represents the under surface of the occipital bone, C being the acquired facet.

Fig. 25 represents the anterior surface of the atlas with a prolongation upwards from its anterior arch, also the large quadrilateral column of bone which stands upon the upper surface of the left lateral mass and articulates with the jugular process of the occipital bone.

Fig. 26 represents the axis and third cervical vertebra of the shoemaker, the prolongation upwards of the odontoid process, with its articular facet, the formation of a layer of bone connecting the arches of the axis and third cervical vertebra, and the position of the ankylosed articulation of the articular process. The cause of the destruction of the intervening soft parts, and the union of the vertebræ to one another in this as in other laborious pursuits, is fully explained in the original paper in the *Journal of Anatomy and Physiology*, July, 1888, "The Anatomy and Physiology of the Shoemaker."[1] I have frequently seen these con-

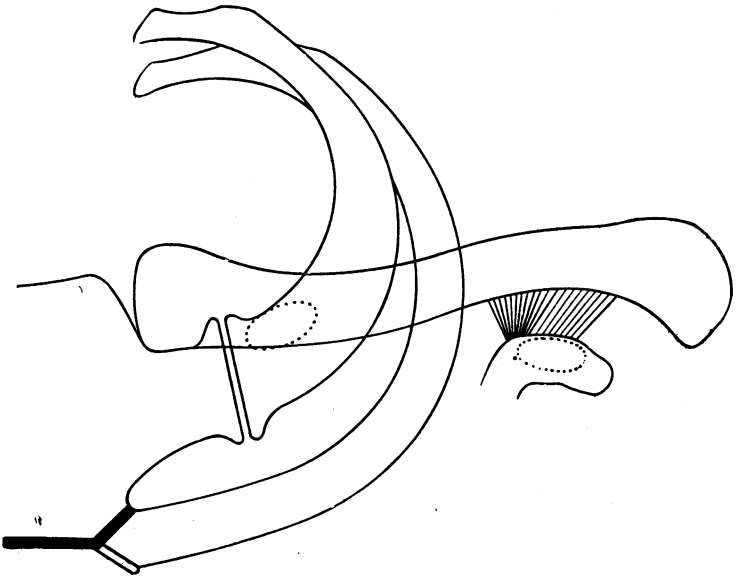


FIG. 19.

Represents the left first and second costal arches, with the manubrium, clavicle, and coracoid process, of a labourer.

ditions exhibited as cured tubercular or other disease of the spine by surgeons, and congenital union of bone by anatomists. Besides showing very clearly the great changes which result from the habitual exercise of very considerable pressure, the elbow-joint of a coal-trimmer illustrates the same law, since both the olecranon and coronoid depressions have been filled up by dense bone-joint sufficiently to limit the range movement in the elbow to the extent requisite for the perfect performance of the occupation of a coal-trimmer. Such a change cannot result from pressure or from strain, since these cavities are not exposed to the

[1] *Journ. Anat. and Physiol*, 1888, xxii, pp. 593-628.

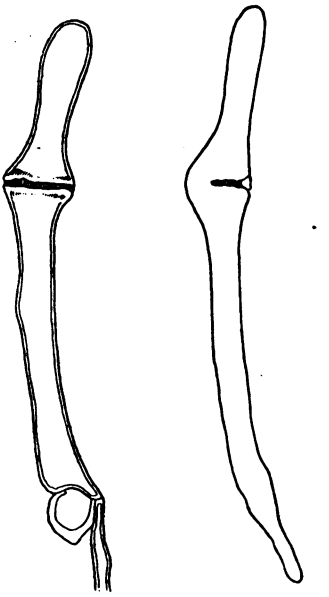


FIG. 20. FIG. 21.

Figs. 20 and 21 show the changes that take place in the manubrio-gladiolar joint in consequence of the transmission through it of great pressure. These specimens were obtained from the bodies of labourers who had been engaged in heavy porterage work at the docks.

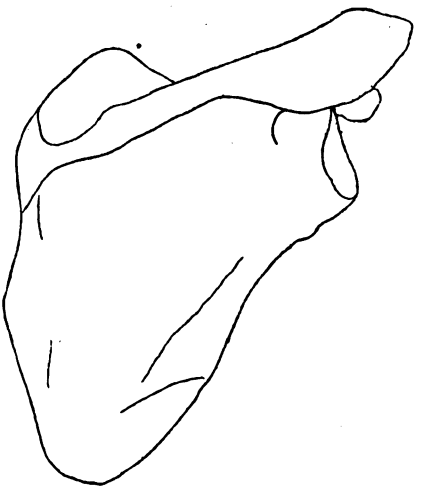


FIG. 22.

Scapula of shoemaker.

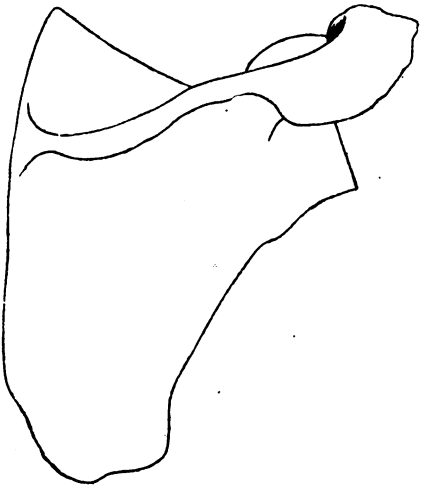


FIG. 23.

Scapula of deal-porter.

action of force in this manner, but it arises because it is advantageous and economical to the individual in his peculiar relationship to his surroundings, or, in other words, in his occupation.

In fig. 27 the joint is shown at its limit of flexion. The manner in which the humero-ulnar segment is strengthened by buttresses of bone, which increase the area of the articular surfaces and render the fit more accurate, is noteworthy. The range of flexion and extension is much limited, for reasons of economy, by the formation of bone in the coronoid and olecranon fossæ. These are seen in fig. 28, where the coronoid fossa

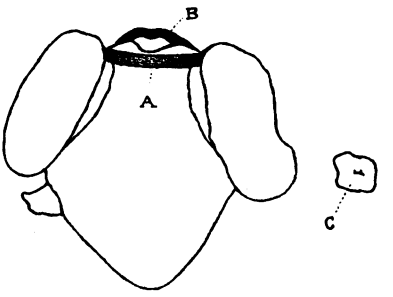


FIG. 24.

FIG. 25.

Atlas of shoemaker.

FIG. 26.

Axis and third cervical vertebra of shoemaker.

and the depression for the head of the radius are rendered shallow by the deposit of bone on their floor.

Again, an attitude of rest if assumed habitually in the child becomes fixed and exaggerated. Here the presence of the growing line assists in the production of an alteration in the form of the bones; this factor being usually absent in the labourer who does not commence to do heavy work till his skeleton is fully developed. The attitude of rest in advanced age can best be studied in the skeleton of the feeble old subject.

Many of the changes in feeble old age are illustrated in the following diagrams :—

Figs. 30 and 31 represent vertical median sections through the bodies of feeble old subjects. Note the resting position of complete

FIG. 27.

Right elbow-joint of coal-trimmer.

flexion of the several parts of the spine. In the lower part of the spinal column the habitual flexion of the lumbo-sacral joint has resulted in an abrupt bend of the sacrum in the one case and in the other of a more general yielding, producing in both a considerable

diminution of the conjugate diameter of the pelvic brim. The intervertebral disks disappear at the points of greatest pressure, their total bulk being proportionately very much less than in vigorous life. The shading represents alteration in the structure of the bones, loss of function of a part rendering the cancelli less conspicuous while the transmission of an excessive pressure exaggerates them.

So far I have confined my remarks and illustrations entirely to the consideration of the bony skeleton and its articulations; what I wish now

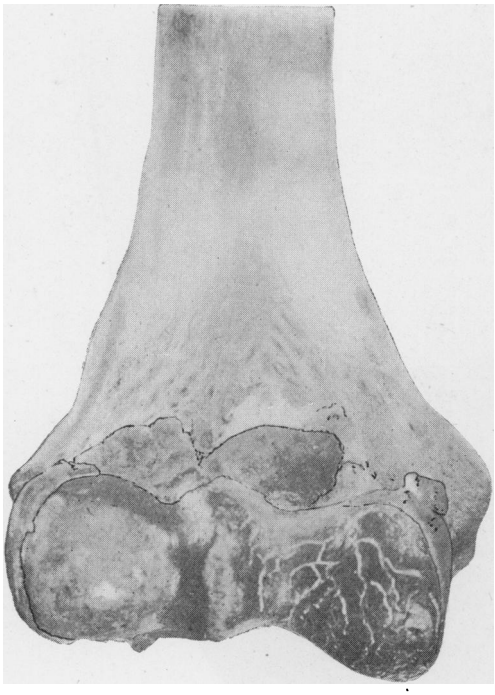


FIG. 28.

Lower end of right humerus of coal-trimmer.

FIG. 29.

Upper end of right radius of coal-trimmer.

to do is to point out that the same mechanical principles govern the soft parts and modify their structure. In addition to this we have the fact that the several viscera, and much more especially the brain, exert a varying influence on the bone-forming capacity of the individual.[1] All these evolutionary processes are useful to the individual in his special

[1] "The Factors which determine the Hypertrophy of the Skull in Mollities Ossium, Osteitis Deformans, Rickets, and Hereditary Syphilis," *Lancet*, 1888, i, p. 815.

mechanical relationship to his surroundings, since they economize expenditure of energy. One must, however, recognize that while these processes are advantageous in the pursuit of his particular occupation,

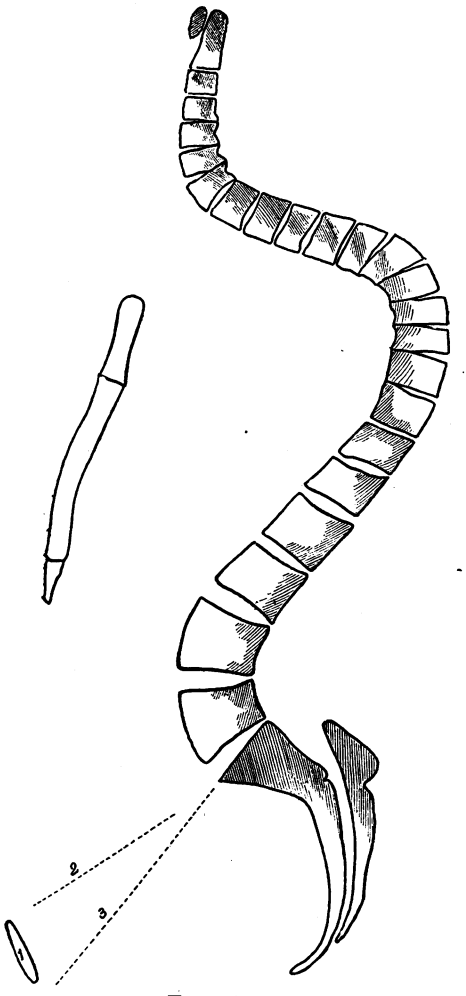


FIG. 30.
Spinal column of old woman.

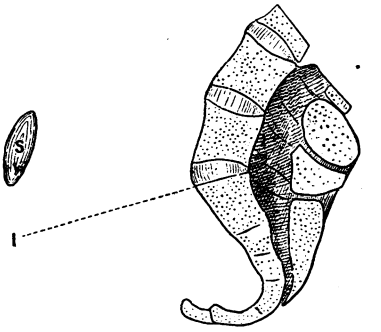


FIG. 31.
Lower part of spine of feeble old subject.

they are subsequently all more or less instrumental in tending to shorten his life.

We are quite familiar with the relatively short life of the labourer, the duration of whose existence may be said to vary inversely as the severity of his occupation as regards manual work. How far these

mechanical agencies act as evolutionary factors in determining changes in the offspring I have considered in an earlier paper.[1]

In civilization the trunk is retained in a vertical position during the entire daytime, the reclining posture being only assumed at night. Even then the horizontal posture is modified in character from that normally assumed in savage life. The resting posture of the trunk is the prone position, which is that which is naturally assumed in sleep upon the ground. While in the erect position of the trunk all the viscera tend to displace downwards towards or into the true pelvis, in the prone position the tendency is for them to fall upwards and forwards out of or in a direction away from it. If these attitudes were assumed in a normal association the structures in the abdomen would retain their normal relationship to the abdominal wall and to one another. If, however, the attitude of activity is not compensated for sufficiently by the corresponding resting posture changes will certainly take place, varying in degree with the failure of compensation. It is now our business to study in detail the changes which arise in the several abdominal structures in consequence of this. The portion which is affected in the first instance is our drainage scheme, or, as it is commonly described, the gastro-intestinal tract.

The large intestine forms the cesspool of this tract. As it retains its contents for a comparatively long time, and as most of these contents are of solid consistence, it is natural that by its weight and situation it should tend to become displaced earlier in the lifetime of the individual.

In the erect posture the cæcum and ascending colon become filled with more or less fluid contents, and by exerting a hydraulic pressure on the cæcum tend to tire out its muscular wall and dilate its cavity. By the same means there is a tendency for the dilated cæcum to be displaced downwards into the true pelvis, where its presence is detrimental to the true comfort and functioning of the viscera, to which that space normally belongs.

This tendency to displacement in the cæcum in a downward and inward direction may be regarded as acting along the resultant of a parallelogram of forces, and to oppose this tendency resistances develop which correspond in position and action to the sides of the parallelogram. These lines of resistance are crystallized first as bands, and later as distinct membranes, which, as the outer limbs of the parallelogram,

[1] "Can the Existence of a Tendency to Change in the Form of the Skeleton of the Parent result in the Actuality of that Change in the Offspring?" *Journ. Anat. and Physiol.*, 1888, xxii, pp. 215-24.

connect the peritoneum lining the abdominal wall to the outer surface of the colon in its immediate vicinity. A larger area of abdominal peritoneum and of colon is gradually involved, and later still, as is the case in all resistances which are crystallized in peritoneum, the bands are replaced by a layer of peritoneum which clings and tends to support the colon from the outside. As these bands and membranes develop, blood-vessels form in them which later may become sufficiently large to require to be ligatured if divided. This particular resistance, when fully developed into a membrane, has recently been termed "Jackson's membrane," and the manner in which it should be dealt with has afforded surgeons an excuse for doing many operations whose object is not very apparent, and which suggest ignorance of the factors determining its development as well as of its function. These crystallized resistances of peritoneum are not limited to the cæcum, but may extend up along the outer aspect of the ascending colon, even to the hepatic flexure.

At this flexure a number of new bands are formed overlying the normal peritoneum and attaching the flexure. These bands as they develop drag the flexure upwards, and in some cases produce a distinct obstruction. As they are fixed in close relationship with the right kidney, they not infrequently produce symptoms which are regarded as being renal in origin. In consequence of this the right kidney has been frequently exposed in an ineffectual attempt to find a stone, and the surgeon has subsequently been agreeably surprised to find that his patient has been relieved of his pain merely by the exposure of the kidney. The relief, usually temporary, really results from division of many of these bands and the freeing of the obstruction at the hepatic flexure. The bands or membranes are liable to constrict the lumen of the ascending colon usually at the level of the crest of the ileum.

The inner limb of the parallelogram of forces is represented at an early period by opaque streaks on the under surface of the mesentery, attaching the last few inches of the ileum, and commencing at its base at a point most distant from the bowel. The reason of this development is obvious. Besides retaining the end of the ileum in position, the mesentery assists through the medium of the termination of the small intestine in holding up the cæcum and in tending to oppose its downward displacement.

The thickening in the under surface of the mesentery becomes more distinct, and later develops into a membrane which extends to, and secures, the under surface of the circumference of the ileum, and

gradually creeps around it till it reaches that portion of the circumference immediately opposite to the attachment of the mesentery. As it extends around the ileum, it also contracts, with the result that it twists the ileum on itself along its longitudinal axis. In its earliest development, as is the case with most conditions which evolve during the lifetime of an individual, because of a variation from the normal in the relationship to his environment, the effect of this acquired ligament or mesentery is useful and physiological, but later, when it kinks and obstructs the lumen of the ileum, it exerts a progressively deleterious effect on the well-being of the individual. I have already called your attention to the harm done by structures which, when first evolved, perform a useful function, but later produce effects which are progressively deleterious. I have indicated the mechanics of these crystallized resistances in figs. 32 and 33.

Fig. 32 represents the distended loaded bowel dragging upon the resistances evolved to oppose its downward displacement into the true pelvis. The resistances external to the cæcum are indicated as arrows showing the general direction of the strain exerted by bands, adhesions, and omental structures. The lowest of these secures the appendix, which in these circumstances is kinked. The effect exerted upon the ileum at its point of fixation by the weight of the loaded cæcum on the one side of it, and by that of the obstructed loop of the ileum on its proximal aspect, is figured in the diagram.

Fig. 33 represents the anchored portion of ileum with its mesentery in an antero-posterior plane. The contracting bands which develop on the under surface of the mesentery, shortening it and attaching progressively a varying portion of the circumference of the ileum in the vicinity of the mesentery with the consequent alteration in the form of the bowel, are shown by the arrow. The compensatory shortening of the entire mesentery in this plane is not indicated in the diagram.

It is clear that in this condition the inner limb of the parallelogram of forces is represented by the portion of the ileum distal to the kink, by the contracting acquired membrane which creeps around the circumference of the bowel, and by the posterior layer of the mesentery to which the membrane is attached. The upper layer of the mesentery presents no change, as abnormal strain is not exerted along it but through the under layer only. In these circumstances the portion of ileum between the cæcum and the attachment of the acquired ligament is made to perform the function of a ligament very much more than is the case in the normal arrangement.

In figs. 34 and 35 are excellent clinical illustrations of this condition. They are contained in a paper by Dr. Charles H. Mayo in *Surgery, Gynæcology and Obstetrics*, entitled "Intestinal Obstruction due to Kinks and Adhesions of the Terminal Ileum,"[1] in which that dis-

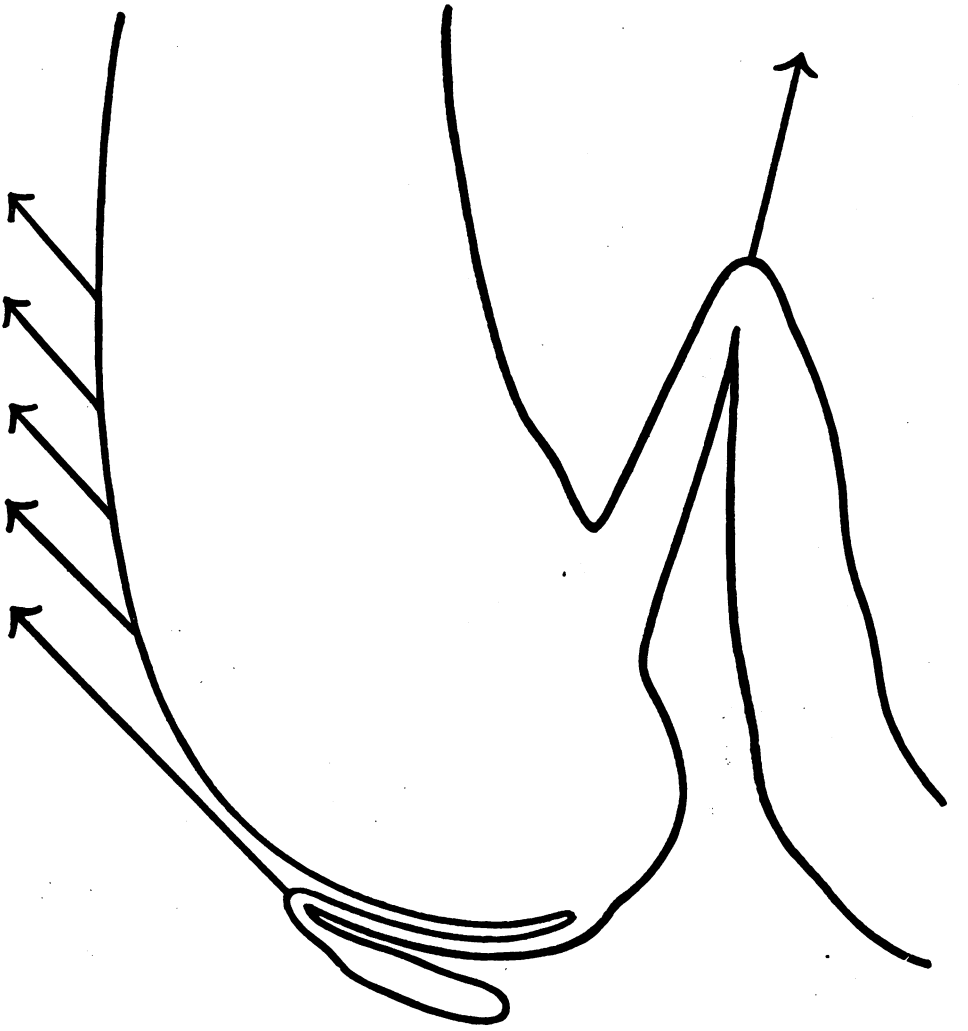


FIG. 32.

tinguished surgeon describes his views on the causation of the condition.

You will note that in the case here illustrated the appendix is fixed by the bands forming part of the outer limb of the paralellogram of

[1] *Surg., Gyn. and Obstet.*, Chicago, 1911, xii, p. 227.

forces, and that it has no anatomical relation whatever with the acquired evolutionary band forming the ileal kink, nor can it by any possibility have had any share in its causation. This may seem an unnecessary observation, but it is called for, since certain surgeons labour under the delusion that the band is produced by an inflammation that started spontaneously in the appendix. Against the supposition that these acquired bands or mesenteries are inflammatory in origin is the fact that they commence at the reflexion of the peritoneum at a point most distant from the intestine, and then gradually approach and secure the bowel. Also, they only exist on the surface of peritoneum on which strain is exerted, and they correspond accurately to the lines of force.

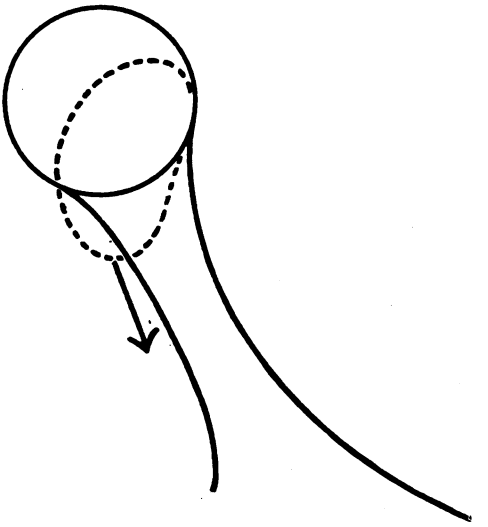


FIG. 33.

The gradual growth of these membranes can be studied in every degree of development in the mesentery of the iliac colon. A very little consideration shows that the inflammatory origin is absurd.

I would also refer to excellent work on the same subject, as well as on stasis generally, by Dr. Franklin H. Martin[1] and by Dr. Coffey,[2] which has appeared in *Surgery, Gynæcology and Obstetrics*, and with all of which you are doubtless quite familiar.

From an examination of the several illustrations, it is apparent that any accumulation in the ileum proximal to the kink aggravates the obstruction more or less effectually, and that in the supine, and especially in the prone, posture the reduction of the strain exerted in

[1] *Surg., Gyn. and Obstet.*, Chicago, 1911, xii, pp. 34-40.
[2] *Ibid.*, 1912, xv, pp. 365-429.

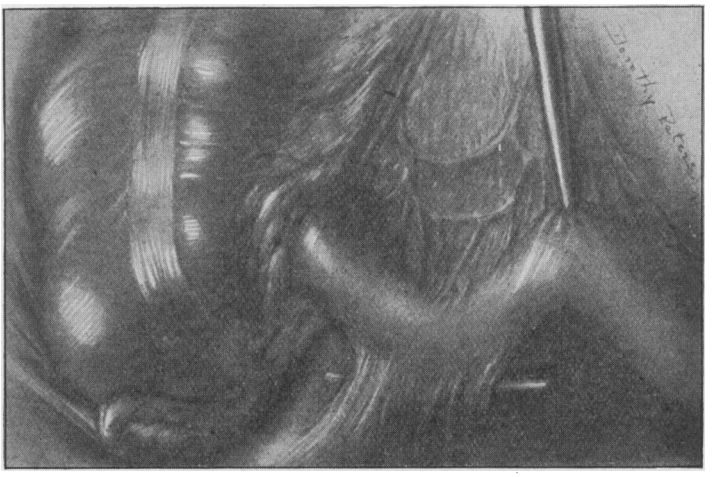


FIG. 34.

Shows the ileal kink with the band of peritoneum which produces it.

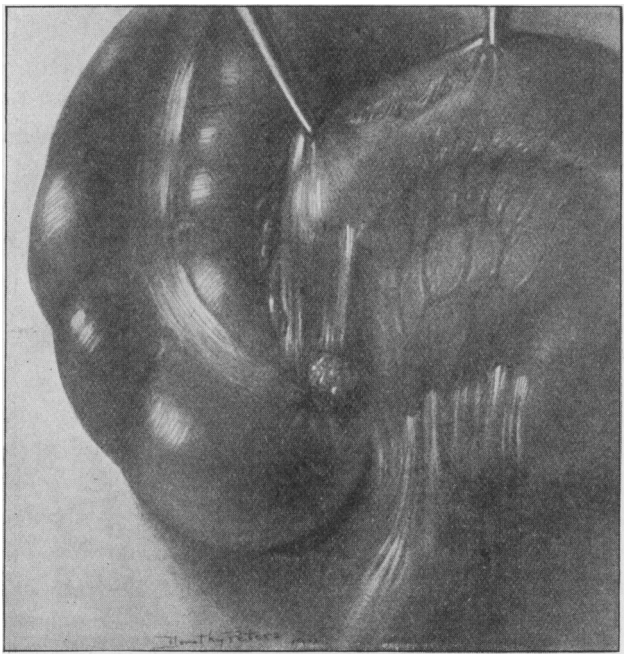


FIG. 35.

Represents the condition after division of the controlling membrane.

the kinked bowel is probably sufficient in most cases to re-establish the effluent through it more or less satisfactorily. This is the explanation of the improvement which results in conditions presenting a marked ileal kink when the recumbent posture is assumed.

A factor of more immediate urgency in the development of resistances to the descent of the cæcum is the share taken by the appendix. This structure being a firm one, and being securely fixed to the summit of the cæcum, offers an irresistible attraction to the acquired or evolutionary bands. It may be gripped by one of them forming the outer limb of the parallelogram as in figs. 32 and 34, when the portion of its length, which intervenes between the point of attachment by the band and the cæcum, is made to perform the function of a ligament. Should the grip of the acquired band secure the appendix at a point in its length, it is liable to kink the appendix when the blind part distal to the secured point readily becomes obstructed. The worst that such an appendix can do is to become inflamed, producing the condition called appendicitis. Should the appendix, on the other hand, form part of the inner limb of the parallelogram of forces, it is caught up at a point in its length, and is secured by an acquired band or ligament to the under surface of the mesentery. To reach this attachment it has to pass almost directly upwards behind the termination of the ileum. In these circumstances the inner limb of the parallelogram is formed by a portion of the proximal appendix stretched to its utmost and continued in the lower layer of the mesentery into a thick, dense, fibrous and peritoneal band, which has developed in order to secure it in this position. If the appendix is strong and the grip afforded by the acquired ligament or membrane in the under surface of the mesentery is secure and efficient, the acquired band which develops for the purpose of utilizing the termination of the ileum does not form. If, on the other hand, the hold of the appendix in the mesentery is not effective in restraining the cæcum, in that proportion does an acquired mesentery and ileal kink result. When they co-exist, the band fixing the appendix may become continuous with the band kinking the ileum. This has led those observers who consider that the fixation of the appendix is secondary to a primary inflammation of that organ to imagine that the membrane producing the ileal kink is also formed by an inflammation of the appendix. A careful examination of the condition at once disposes of such a supposition.

The appendix, fixed to the mesentery, exerts a pressure upon the end of the ileum, when the cæcum falls into the pelvis and the ileum

becomes dilated and distended behind the control, which is exerted by the unyielding and practically rigid band formed by the proximal portion of the appendix and the ligament which secures it. As the appendix is usually gripped in such a manner that only a portion of its length is held by the acquired ligament, the portion distal to this, as already pointed out, is liable to become obstructed beyond its kink, and an inflammation of its distal extremity, or in other words an appendicitis, may arise. Therefore, such an appendix, by acting mechanically, may not only produce all the consequences associated with the damming back and fouling of the contents of the small intestine, but its end becoming inflamed, it adds to these mechanical symptoms those of appendicitis.

It has been observed by certain operators that the removal of the appendix may occasionally bring about a cure of such conditions as duodenal ulcer, &c., and it has been suggested that duodenal ulcer and allied conditions are produced by an infection by organisms which grow in the appendix, or it is assumed that they may be produced by other infections—e.g., pyorrhœa alveolaris, &c.

While the fact is correct that the removal of the appendix is occasionally followed by the cure of duodenal ulcer and allied conditions, the explanation of the phenomenon is incorrect. The ulcer and other allied conditions get well because the appendix, which was removed, had controlled the effluent in the ileum, and the freeing of this ileal effluent has of necessity relieved the results of its obstruction, of which the duodenal ulcer was one and only one.

The problem of ileal obstruction, either by an ileal kink or by the pressure of an appendix secured to the back of the mesentery, or by both sharing in the production of obstruction of the ileal effluent, is one of the greatest importance and frequency. If I might so describe it, it represents the failure of our present condition of civilization.

I have endeavoured to indicate diagrammatically, in fig. 36, the normal condition of the stomach, small intestine, and cæcum, and in fig. 37 the several changes which result from ileal obstruction.

I have endeavoured in fig. 38 to indicate the mechanism of the appendical tie or resistance when it forms the inner limb of the parallelogram of forces. The cæcum and ileal loop are both distended with fæcal contents and have fallen into the true pelvis. The end of the ileum is hung over, and its lumen is diminished by, the fixed portion of the appendix secured by its acquired membrane or crystallized resistance, which is represented by the arrow. It is apparent that the

greater the drop of the cæcum as it pivots on the fixed appendix, and the greater the dropping and distension of the ileum, the more complete does the obstruction by the appendical tie become.

I should further like to point out that while the obstruction to the passage of the contents of the ileum into the cæcum usually results from a kink in the ileum, a suspending appendix, or from both together, yet the cæcum and ileum may bear such a mechanical relationship to one

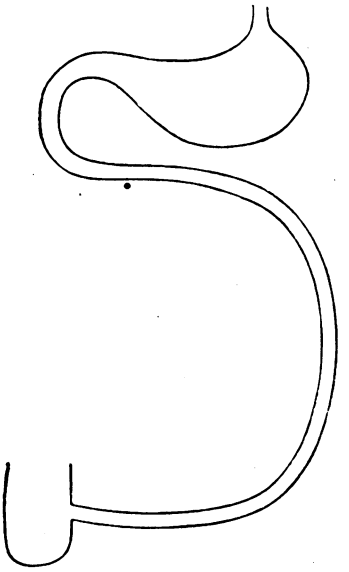


FIG. 36.

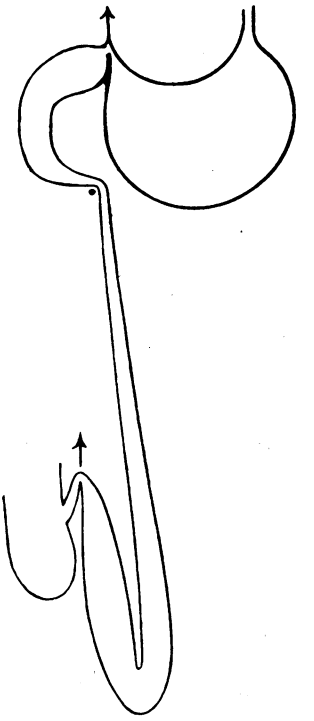


FIG. 37.

another, either because of the fixation of the cæcum in the iliac fossa by the bands of resistances forming the outer limb of the parallelogram of forces, or because of a distension of a large cæcum with fæcal contents occupying the true pelvis, that the ileum is unable to transmit its contents at a normal rate into the cæcum, so that it becomes obstructed and distended, and its contents infected by organisms to which it is unaccustomed. Associated with the obstruction at the end of the small intestine, the lowest portion of the ileum presents a condition of dilatation and hypertrophy varying in degree with the character of obstruction

and the vitality of the individual. If the subject is still fairly vigorous the bowel is very distinctly hypertrophic, but if the condition is very advanced the intestine is dilated, or even bluish, as it would appear on the post-mortem table. The pull exerted by the prolapsed small intestines, rendered heavy with their accumulated contents, exerts through the medium of the jejunum a strain on the termination of the duodenum. The duodenum usually terminates vertically at the root of the transverse

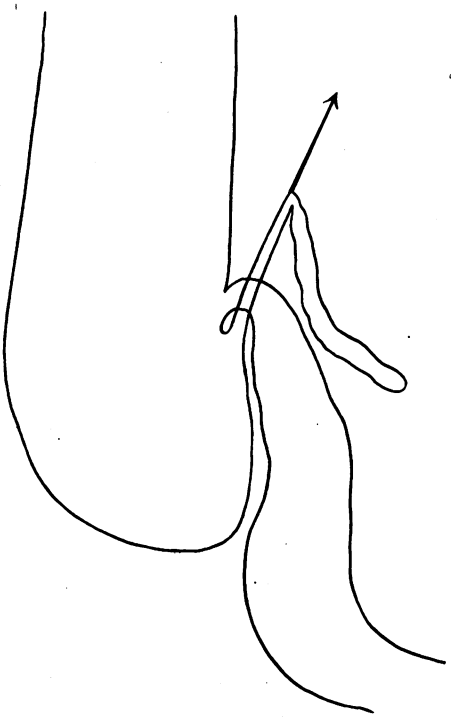


FIG. 38.

mesocolon, where it is continued into the jejunum as a gentle curve. This I have endeavoured to indicate in fig. 39. The strain exerted by the jejunum produces a kinking of the duodeno-jejunal junction, together with a twisting of the commencement of the jejunum. This produces an obstruction to the effluent from the duodenum. To oppose this drag upon the jejunum and the obstruction of the duodenal outlet consequent on it, resistances are laid down as peritoneal bands. These run upwards and outwards from the commencement of the outer aspect of the jejunum to the peritoneum lining the adjacent abdominal wall. At first

these acquired or evolutionary bands or ligaments serve a useful and physiological purpose, but after a time, as they contract they secure the bowel in this vertical position, and no longer permit it to return to the normal curve in any position of the body, so that the duodenal outflow is permanently obstructed, this obstruction becoming exaggerated at times when the patient is exhausted. I have attempted to represent

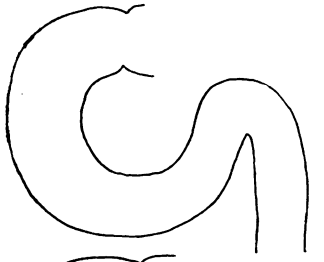


FIG. 39.

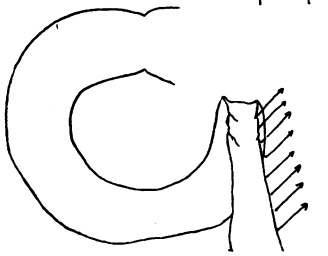


FIG. 40.

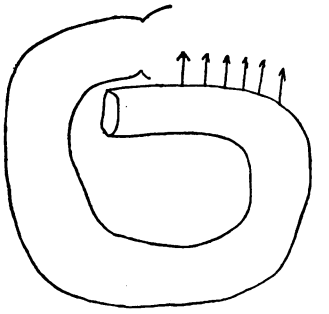


FIG. 41

the kinking and twisting of the bowel in fig. 40, and also to show the situation and direction of the crystallization of the lines of resistance in peritoneal ligaments or membranes.

It happens not uncommonly that Nature, recognizing the importance of avoiding annulation at and strain upon the duodeno-jejunal junction, develops resistances crystallized in membrane which fix the jejunal loop so as to avoid kinking. The jejunum becomes secured from left to right to the under surface of the transverse mesocolon by peritoneal

bands or membrane. This I have indicated in fig. 41. By this means Nature obtains the same result that is arrived at by the surgeon who performs an anterior or posterior gastro-enterostomy for duodenal ulcer which does not mechanically obstruct the lumen of the duodenum. He simply secures the commencement of the jejunum, so that it cannot fall vertically and continue to obstruct the duodenum. Should the stomach be much dilated he may not even succeed in doing this owing to its continued dropping. In no case does the relief of the duodenal obstruction relieve the obstruction at the end of the ileum, with the consequent stasis and infection of the small intestine, and with the auto-intoxication which results from it.

The obstruction at the duodeno-jejunal junction produces a distension of the duodenum with dilatation of its lumen and hypertrophy of its wall. This is most marked in the first portion which is covered by peritoneum and has not the same support from the adjacent structures that the rest of the duodenum possesses. In consequence of the distension of the first piece of the duodenum and because of the infection of its contents by organisms to which it is unaccustomed, and of the depreciation of its vitality by the auto-intoxication, changes take place in its mucous membrane which are at first of the nature of vascular engorgement, and later of inflammation of varying degree, till an ulcer may form which may eat its way through the muscular and peritoneal coats. It may heal, cicatrize, and stenose this portion of the bowel.

The infection of the duodenal contents results in the fouling of the ducts which open into the duodenum—namely, the pancreatic and common bile-ducts. The extension of organisms up the duct of the pancreas, assisted by the depreciation in the vitality of this organ from the general auto-intoxication of the tissues, and possibly from the presence of deleterious organisms in the circulation, produces changes in the pancreas which vary from a mere vascular engorgement to the several stages of inflammation, and lastly may end in cancer of the organ itself.

The infection of the gall-bladder produces gall-stones in the gall-bladder, and on rare occasions in the hepatic ducts. Changes ensue in the wall of the gall-bladder consequent on the presence of stones in it or in the cystic duct. These changes are of an inflammatory or cancerous nature. Similar changes may occur in the liver and in its ducts secondary to stone in the common bile-duct, pancreatic inflammation, &c.

Later, the cicatrization of the duodenal ulcer produces more or less

definite occlusion of the lumen of this portion of the bowel, with consequent changes in the stomach. Associated with the distension of the duodenum the pylorus develops a varying amount of spasm, obviously to prevent the return of the duodenal contents into the stomach. This produces a distension and dilatation of the stomach with a varying degree of hypertrophy of its coats. This accumulation of material in the stomach throws a strain upon the lesser omentum at its right limit, and resistances to the downward displacement of the pylorus crystallize as bands or adhesions which connect the pylorus progressively to the under surface of the liver and gall-bladder. An acquired band may extend from the under surface of the liver to the pylorus, which it thus fixes, and by passing on into the transverse colon will tend to secure that structure. Thus by transmitting its strain directly to the liver it will free the stomach from a portion of the weight of this part of the bowel. The distended, loaded stomach sustains the greatest strain along its lesser curvature. The strain is greatest near the pylorus because of the limited area of resistance and gradually diminishes as it approaches the œsophagus. This latter structure may be regarded as the chief supporting ligament of the stomach in the erect posture. Any descent of the liver brings the strain in the lesser curvature nearer the œsophagus and farther away from the pylorus. The strain exerted upon the lesser curvature of the stomach by the contents accumulated in it is increased by those portions of the strain which are transmitted through the greater omentum to the convexity of the stomach by a loaded transverse colon. In consequence of this strain, assisted by the bacteriological and chemical changes in the gastric contents and by the lowered vitality undergone by the tissues of the stomach and of the body generally by auto-intoxication, changes take place in the mucous membrane which vary from an increased vascularity to a cancerous infection (*see* fig. 42).

To bring about ulceration of the stomach, it is apparent that the mechanism which is responsible for the production of ulceration of the duodenum has superadded to it a distension of the stomach, with probably much stasis in the transverse colon. Therefore, while in most cases recumbency relieves the ileal stasis and consequently the duodenal distension and so permits the ulceration to get well, in the case of the ulceration in the stomach the recumbent position does not cure the stasis nor does it relieve the pyloric spasm, nor remove the stasis in the transverse colon. This explanation of the causation of the gastric ulcer is also confirmed by the benefit which frequently results from an efficient gastro-enterostomy. By efficient I mean one which allows the free passage of gastric contents in the jejunum.

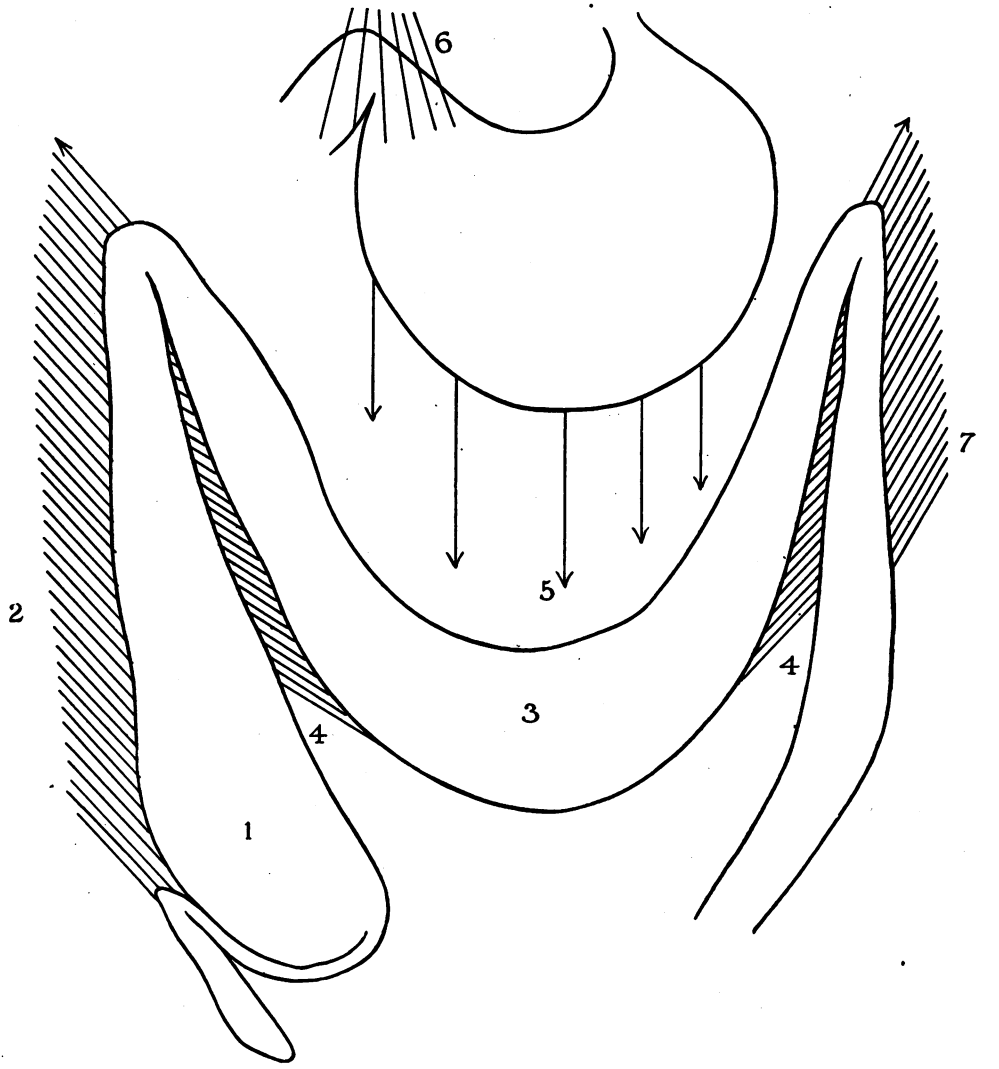


FIG. 42.

1 represents the prolapsed cæcum ; 2 and 7, the crystallized resistances which tend to oppose the downward displacement of the large bowel and sustain some of the weight of the transverse colon transmitted through the crystallized resistances 4 ; 3, the transverse colon ; 5, portion of the weight of the transverse colon transmitted through the great omentum to the convexity of the stomach ; and 6, the acquired ligament that secures the duodenum and pylorus to the under surface of the liver and gall-bladder.

The rapidity with which duodenal ulcer can usually be temporarily cured by position, explains the great rarity of infection of such an ulcer by cancerous germs, while the difficulty of curing gastric ulcers renders them chronic and liable to such an infection.

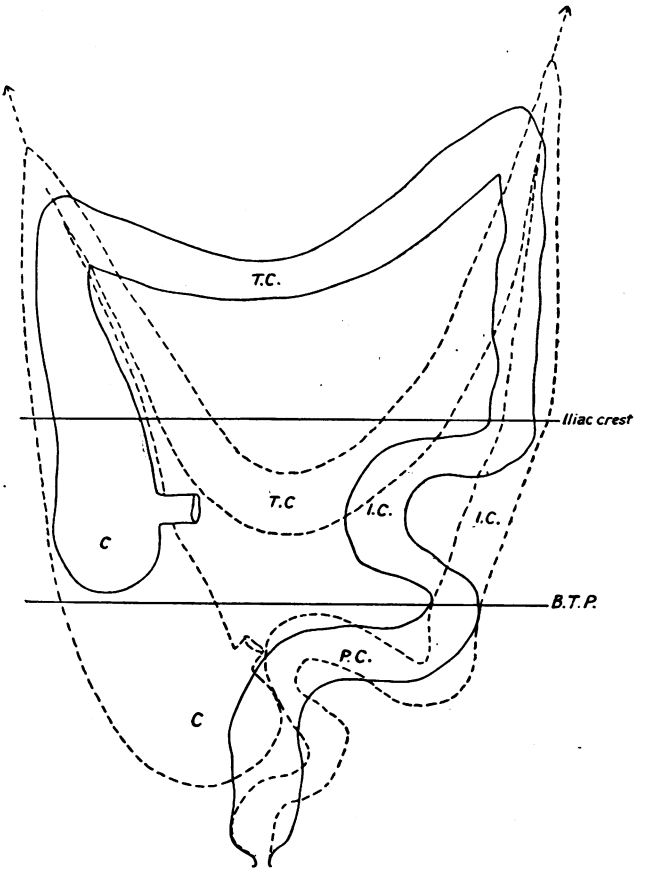


FIG. 43.

Fig. 43 represents the several variations from the normal which the large bowel undergoes. The normal condition is shown as a firm outline, and the altered condition as a dotted outline. Note the prolapse of the cæcum and transverse colon, the telescoping of the iliac colon and the elongation of the pelvic colon. *B.T.P.* indicates the brim of the true pelvis. The hepatic and splenic flexures are drawn up and kinked by the development of acquired resistances shown as arrows.

Returning to the large bowel, the transverse colon tends to drop. Part of its weight is transmitted to the convexity of the stomach through the great omentum and part through an acquired mesentery,

which develops between the convexity and the ascending and descending colon. This acquired membrane is the crystallization of resistances to downward displacement of the transverse colon and is in the first instance useful since it serves to relieve the stomach of strain. Later by its contraction it renders the hepatic and splenic flexures more acute and affects deleteriously the passage of fæces through them. As I pointed out, this is the usual sequence in the case of changes which evolve during the lifetime of an individual. Much of the weight of the transverse colon is transmitted through the posterior layer of the transverse mesocolon, which shows distinct acquired thickening and sometimes independent membranes along the lines of greatest strain. The splenic flexure is, normally, much higher than the hepatic, and in cases of stasis it is still further elevated by the formation of membranes

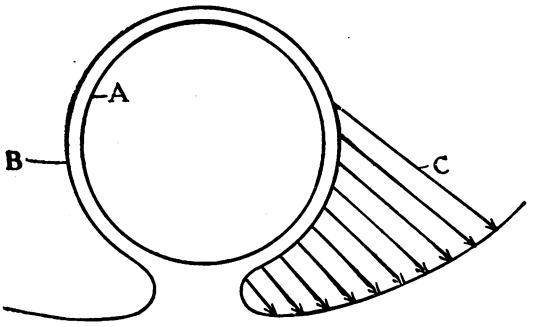


FIG. 44.

Transverse section seen from above. A, muscular and mucous coats; B, peritoneum; C, direction of adhesions.

or acquired resistances, which by their progressive contraction accentuate the angulation and disability of this flexure. It is at the three flexures, and especially at the splenic flexure, that inflammatory and, later, cancerous changes are liable to develop in consequence of the constant irritation due to the increasing obstruction. The descending colon is fixed in a manner similar to the ascending colon by acquired crystallized resistances, which serve partly to secure the colon and partly to transmit to the abdominal wall the weight of the transverse colon.

Fig. 44 represents diagrammatically the development of these bands. They are liable in time, by their construction, to exert an excessive strain on some portion of the colon, and to produce a constriction in the lumen of the bowel with the consequences which follow upon it. Such an obstruction exists occasionally in the large bowel on the right

side at the level of the iliac crest, where the abrupt change from a firm, bony relationship to that of a flaccid muscular wall renders the production of a kink more easy. The flexure or loop formed by the iliac colon is dealt with in the same manner as I have indicated in fig. 43.

Fig. 45 represents a transverse section through the sigmoid and mesosigmoid and the peritoneum covering the iliac fossa external to the mesosigmoid. As in the last diagram, the line B indicates the peritoneum and the line A the bowel. Owing to the possession of a mesentery of some considerable length, the bowel is at a much greater distance from the abdominal wall than the cæcum and ascending colon, which are immediately adjacent to it, and the mode of fixation differs somewhat in detail from the last described. The outer surface of the mesentery is gradually brought down to its base by the formation of adhesions, till the wall of the iliac colon itself becomes secured to the floor of the fossa. The mode and direction of the formation of these adhesions are represented by arrows, C.

Associated with the progressive fixation of this loop there is a diminution of its lumen and of its length, so that the bowel, which normally forms a loop of considerable size, moving freely at the end of a long mesentery, finally becomes telescoped as a short, straight, constricted tube, attached by a considerable area of its circumference to the abdominal wall quite devoid of any mesentery. In proportion as the bowel becomes fixed, its muscular coat wastes. The state of fixation and shortening of the sigmoid flexure, wasting of its muscular coats, and the general and occasionally also a very considerable local reduction of its lumen, and the obliteration of much of its peritoneal covering, are of great importance surgically, since they interfere very materially with the passage of material through the sigmoid and render any operation on this portion of the bowel abnormally difficult. In consequence of the irritation of the passage of firm fæcal contents through this fixed bowel, inflammation and later cancerous changes develop in it. The former condition—namely, the inflammatory one—has been dealt with in his usual masterly manner by Dr. W. J. Mayo in several papers under the title of "diverticulitis." The fixation of the sigmoid by the acquired adhesions may be of such a nature as to narrow its lumen in one or more places to such an extent that symptoms of obstruction may arise. This results from a failure of many of the bands of adhesion to secure a continuous grip upon the whole length of the mesentery of the loop. In consequence, the part, or parts, of the sigmoid which have become effectually anchored form kinks or obstructions, while the rest

of the loop is distended. I have endeavoured to indicate this diagrammatically in fig. 46. In this the end of the descending colon, DC, is shown with the loop of the iliac colon and the upper part of the pelvic colon. The radiating lines represent the acquired adhesions which have secured the centre of the sigmoid loop, but have failed to grip the portions of the bowel above and below. Consequently the lumen of the intestine is reduced in two places, chiefly at the point where the centre of the loop is fixed, and to a lesser extent at the junction of the distal loop with the rectum.

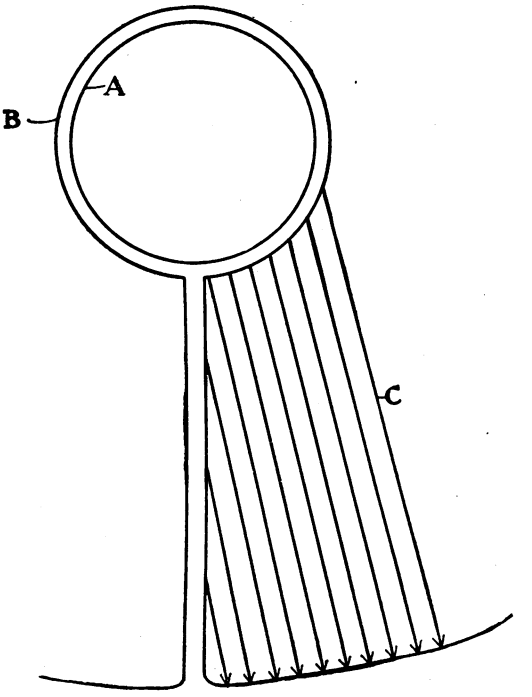


FIG. 45.

A, muscular and mucous coats; B, peritoneum; C, direction of adhesions.

Owing to the bowel having escaped beyond the control of adhesions, except at its commencement and termination, the sigmoid, instead of becoming shortened, atrophied, constricted, straightened, and fixed, may become very much more elongated, dilated, and mobile than normal, its muscular coat being correspondingly hypertrophied. At the same time the extremities of the loop held in the grip of adhesions are closely approximated, while the lumen of each is constricted, especially when

the loop is distended with fæcal matter. This approximation of the extremities of the loop greatly facilitates its rotation.

Fig. 47 is intended to represent the mode of production of a volvulus of the iliac colon. DC, S, and R indicate respectively the lower limit of the descending colon, the sigmoid loop, and the upper part of the rectum. The radiating lines show the acquired adhesions which have secured and approximated the extremities of the sigmoid, but have failed to obtain a uniform grip upon the mesosigmoid generally. The mode of obstruction to the passage of fæces from the sigmoid into the rectum is depicted. This obstruction may become more complete because of a rotation upon the loop upon the base formed by its approximated extremities, or because of an excessive sagging of the lower part of the loop exerting a drag on its lower limit sufficient to occlude its lumen. A certain amount of obstruction to the passage of fæces from the sigmoid into the rectum is always present. It is in these cases that complete intestinal obstruction may occur, owing to the twist or rotation of the overloaded and elongated loop becoming sufficient to prevent the passage of any material from the sigmoid loop into the bowel beyond. It will thus be seen that the so-called volvulus of the sigmoid (occurring spontaneously and not as an after-effect of an abdominal operation) is a phase of a condition of partial obstruction of long standing, the loop being habitually over-distended with intestinal contents, and the passage of fæces from it being chronically interfered with. I do not think that acute volvulus of a perfectly normal sigmoid can occur spontaneously. The same remarks apply equally to volvulus of the cæcum.

I wish now to call attention particularly to the great importance of the last kink or obstruction which is developed in our drainage scheme and which affects the large bowel where it crosses the brim of the true pelvis on the left side. The fuller recognition of the function of this kink, the lowest in position, has helped me to understand the physiology of the large bowel both in the savage and civilized communities. It has also enabled me to deal surgically with the conditions of defective drainage of the intestine more effectually and at less risk to the life of the individual than I was previously able to do. This kink develops very early in life; indeed, I believe the bands which form on the outer surface of the mesentery of this portion of the large bowel, and which, like all other acquired mesenteries and adhesions, are the crystallization of lines of resistance to downward displacement, are the earliest to form in the body. They appear before the erect posture is assumed. I have

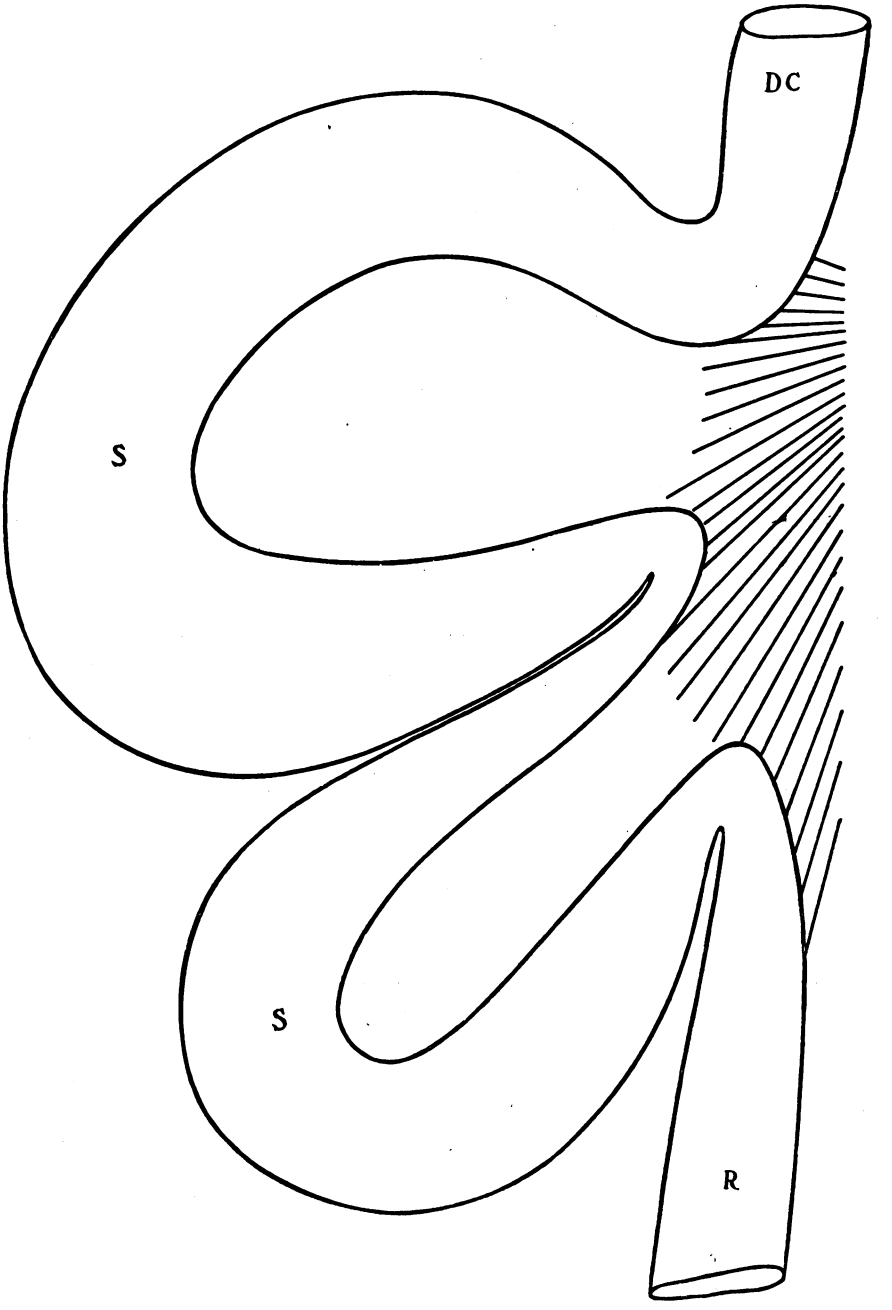


FIG. 46.

found them excellently developed in a child 2 years old, whom I short-circuited for extensive tuberculous disease of the hip-joint. This band obviously develops in order to resist the tendency to the downward displacement of the large bowel into the true pelvis, where it would seriously incommode the functioning of the several organs which already occupy it and is continuous with those that secure the iliac colon. As this new band or mesentery contracts and becomes a definite ligament quite distinct from the normal mesentery, on whose posterior aspect alone it exists, it fixes the large bowel securely at this level, and performs a function of the greatest importance. It is so arranged as to oppose the backward passage of fæces from the pelvic colon upwards into the large bowel, which is likely to take place if this kink or obstruction is not efficiently developed. It is often supposed that the fæcal matter moves continually onwards in its progress through our intestines. That this is not always so is shown exceedingly well in those cases in which this particular kink or obstruction is not developed.

When I first performed ileo-colostomy for intestinal stasis, I divided the ileum and put it into the iliac loop, as it was usually the portion of the large bowel most readily and safely adapted for the performance of this operation. At the same time, great precautions were taken to free the obstruction at the pelvic brim, to which I have just called your attention, by dividing the new mesentery and suturing it over in such a way as to try to obviate its re-formation. This operation was frequently followed by the passage of material back along the descending, transverse, and ascending colon to the cæcum, often necessitating the removal of the large bowel at a later date.

The ovary and Fallopian tube are often involved in these adhesions which fix the colon to the pelvic brim, and the adherent ovary very often undergoes a cystic degeneration. As it increases in size it forms a space in the acquired mysentery in which it moves, its outer wall and the lining of the space enclosing it acquiring a peritoneal covering. Later it destroys the surface of acquired mesentery, which covers its outer aspect, and becomes free except for its attachment to the broad ligament. How far the fixation of the left ovary in adhesions is responsible for the cystic degeneration it undergoes you must judge, but I have seen and demonstrated on many occasions the association of the conditions here described in any stage of development. In some cases the adherent uterine appendages may become infected. The inflammatory process may involve the portion of the colon to which they are attached, and the lumen of the bowel may be diminished

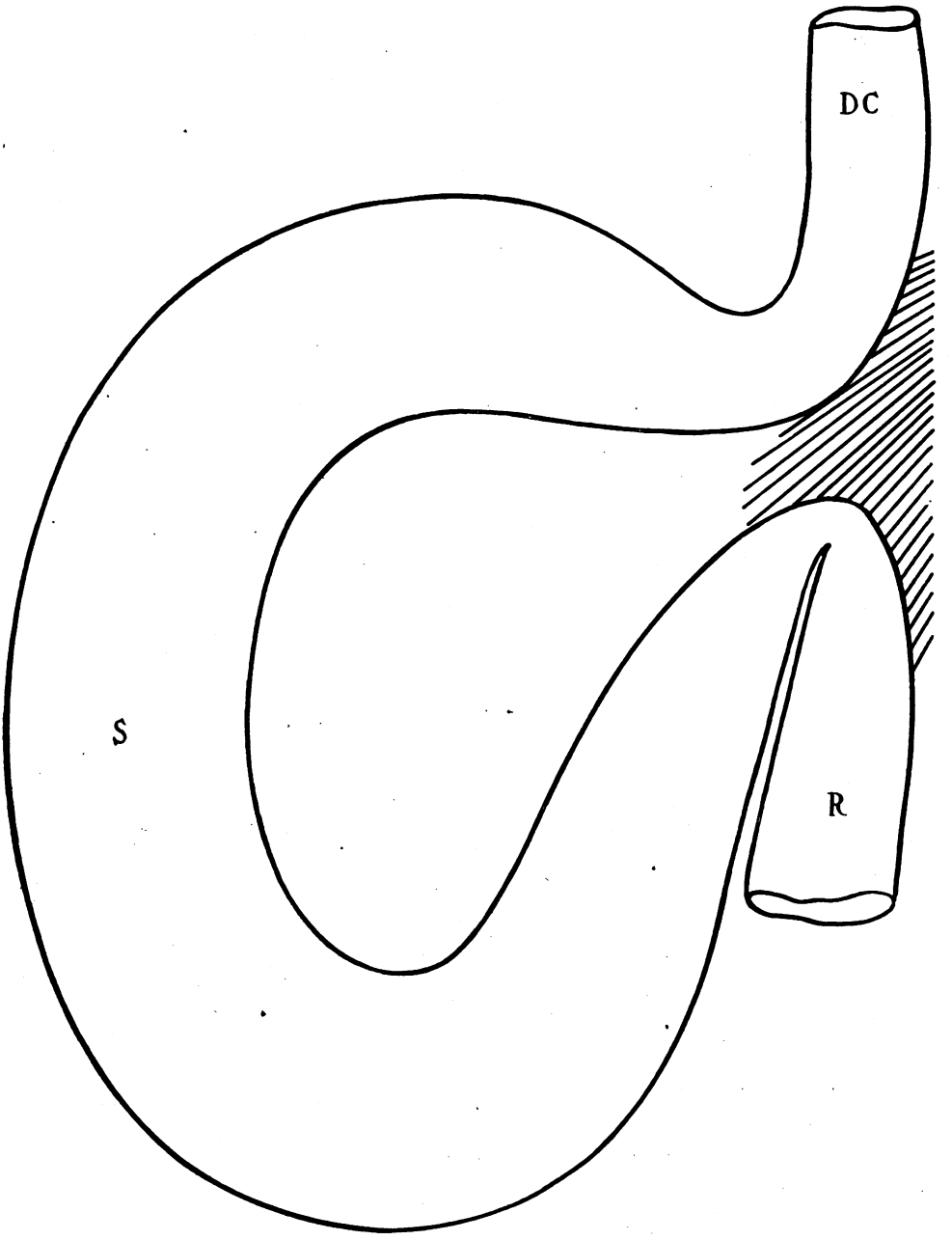


FIG. 47.

sufficiently to produce symptoms of the obstruction and simulate growth. In removing such an infected ovary it is sometimes necessary to excise the portion of colon involved, either because of its constriction or because an abscess in or about the ovary may have perforated its wall or damaged it extensively.

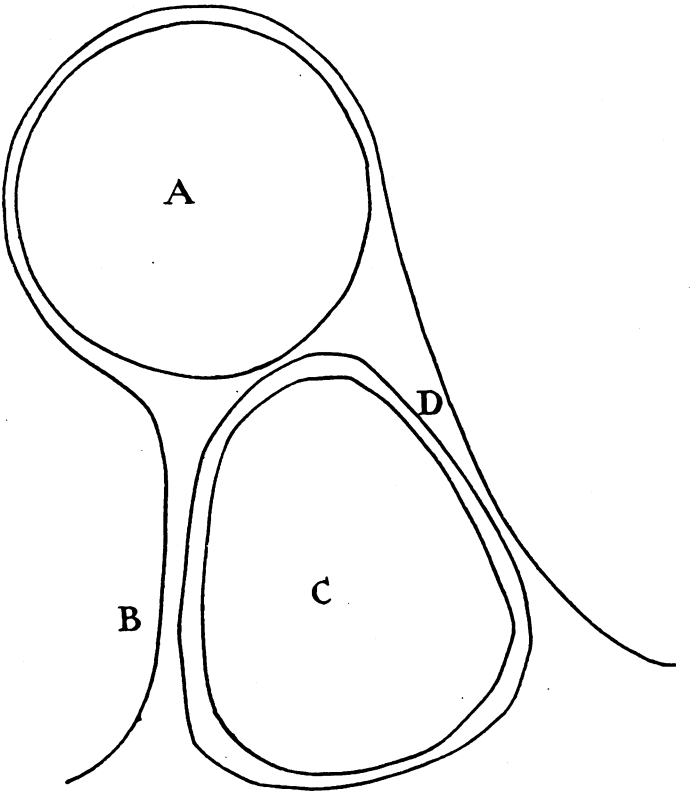


FIG. 48.

A represents the colon in transverse section; B, the original mesentery; C, the cystic ovary lying free in a cavity; and D the remains of the acquired adhesions.

The pelvic colon is sometimes enormously elongated, especially in young life. This is almost invariably a very marked feature in the condition of chronic intestinal stasis, which is associated with tubercle, rheumatoid arthritis, Still's disease, &c. This is true to a lesser extent as age advances. Consequent on the elongation of the pelvic colon this portion of the bowel puddles in the floor of the pelvis and the multiple angulation due to its plication affords an increasing obstacle

to the passage of firm fæcal matter through it. The greater the strain exerted by the abdominal muscles during defæcation the more difficult is it for the material to pass round the sharp angles which are accentuated by the pressure. When the large bowel has been removed or short-circuited the fluid contents pass with less difficulty out through the pelvic colon, but even in these circumstances the constipation in the residual pelvic colon may cause much difficulty to the patient and bother to the surgeon. It is easy to realize how readily inflammation or cancerous infection of the pelvic colon may arise in these circumstances at a point of stress where the mucous membrane has been habitually annoyed by the impact of the firm end of a motion.

The greater frequency of chronic intestinal stasis in the female sex is readily explained by the difference in the mechanical conditions in the sexes. In order that women should perform their function of reproduction their anatomy presents certain definite variations from the male, all of which result in a diminution in capacity to perform hard manual work. The calibre of the cavity of the pelvis is relatively greater than in the male: the lower chest is relatively smaller, the sternum is relatively shorter, the manubrium is relatively longer, the interval between the first and second costal arches is relatively greater and the gladiolus is relatively shorter; the upper portion of the chest is relatively longer; the number of ribs articulating with the sternum being seven and often less than seven, the lower costal cartilages being placed almost vertically and having a very insecure grip on the sternum, while the abdomen, or the interval between the sternum and pelvis, is relatively greater. There are many other differences, for details of which I would refer you to a paper in the *Obstetrical Society's Transactions*, on the chief factors which determine the form of the pelvis in the two sexes.[1] The result of these changes is to render the woman less capable physically than man to meet the conditions of civilization. The habits of life, and the nature of dress, and the concomitants of pregnancy, all assist in reducing the capacity of the abdominal muscles to retain the several viscera in their normal position. The variation in the mechanisms of the abdomen in the sexes also accounts for the somewhat different behaviour of the same organs in men and in women.

As a result, then, chiefly of the habitual assumption of the erect posture, certain mechanical or evolutionary changes take place in our drainage scheme which result in a delay of the contents in part of the tract or throughout its whole length. I felt that the term "chronic

[1] *Trans. Obstet. Soc.*, Lond. (1887) 1888, xxix, pp. 351-68.

intestinal stasis" describes most clearly the condition to which I wish to call attention.

By chronic intestinal stasis I mean such an abnormal delay in the passage of the intestinal contents through a portion or portions of the gastro-intestinal tract as results in the absorption into the circulation of a greater quantity of poisonous or toxic material than can be treated effectually by the organs whose function it is to convert them into products as innocuous as possible to the tissues of the body. This condition can be best studied in those whose habit it is to stand for long periods of time. Butlers, footmen, waiters and those leading similar lives form excellent subjects for illustrating these changes.

Again, those who habitually make such overdrafts on their capital energy as result in temporary exhaustion readily develop these conditions. As one would expect, subjects handicapped by a feeble physique react more rapidly and extensively to the same mechanical factors than do the powerful and robust.

What I want to impress on you is the fact that in our usual state of civilization the trunk of the individual is erect, either in the standing or sedentary posture, from the time he gets up till he goes to bed, and while the trunk is erect, even for an instant, the tendency to the falling of the viscera from their normal position exists, and after a time in favourable circumstances that tendency must become an actuality. This tendency to drop is exaggerated by the results of improper feeding early in life. Even the usual attitude of defæcation is artificial and harmful.

An intimate knowledge of the manner in which the changes in the mechanism of the gastro-intestinal tract come about is of the greatest importance to the physician as well as to the surgeon.

A knowledge of the pathology of delayed or defective drainage of the intestinal tract and its consequences is of paramount importance, since in our state of civilization it affects vitally so many members of the community; indeed, some physical evidence of its existence can be demonstrated in almost any adult subject. This is what one would naturally expect, since we are all exposed in a varying degree to the causes which produce it.

After I had called attention to the mechanics of chronic intestinal stasis the accuracy of my statements was challenged by many. For instance, both the prolapse of the intestines and the acquired mesenteries and adhesions were absolutely and categorically denied by physicians experienced in post-mortem work, who appeared to think that, because

they had escaped their observation like many things have done and will continue to do, they were justified in denying their existence in the most dogmatic manner possible.

The question having been raised, these changes have since been the subject of more careful investigation, and now it is asserted that they are so universally observed that there cannot be any association between them and intestinal stasis. This would all seem to suggest that the methods we adopt are rather crude and the reliance to be placed on them correspondingly small; also that we are inclined to pursue detail rather than attempt to grasp general principles.

The chief difficulties which I have experienced in explaining the several changes which exist is that the presence of the adhesions described by me are regarded as evidence of inflammation. These adhesions, however, do not result from inflammation, but are developed to oppose the displacement of viscera, the tendency to which exists whenever the erect posture of the trunk is assumed.

Having regard to the changes referred to, I think that, however our opinions may differ as to the treatment called for in any particular case, there can be no doubt that the pathological changes which are present in these conditions of imperfect drainage are most obvious and important. Any mechanical interference with the functions of the gastro-intestinal tract is far-reaching in its capacity for harm, and once the mechanism of the intestines has deviated materially from the normal, such alterations, together with the evil results consequent upon them, can only be met by extensive surgical measures, and at a risk commensurate with the degeneration present.

In order that we may be in a position to discuss their treatment we should clearly understand their mechanics, as I have dealt with them fully. You may not accept my description of these changes as accurate, or, if you allow their existence, you may regard the explanation given of their causation as incorrect. Yet I am sure that when your attention is called to them, if you have not already done so, you will take the first opportunity of testing their accuracy in the living body, and will not merely be satisfied to say that you have not previously observed them and that therefore you doubt their existence. Their presence or absence is capable of absolute demonstration.

We will now consider the symptoms which result from the delay in part or in the whole of the gastro-intestinal tract in consequence of or in association with the conditions I have described. I will divide them into two groups—namely, those produced by obstruction and those resulting from auto-intoxication.

The symptoms produced by obstruction are those grouped roughly under the head of indigestion, a term used to cover a great deal of ignorance and much varied treatment. They are chiefly pain, tenderness, flatulence, eructation, &c. These result from an inability to transmit the intestinal contents at a normal rate and from the decomposition of the material consequent on the delay in its transit.

I do not propose to discuss the symptoms of the subsequent consequences of this distension, such as inflammatory changes in the mucous membrane or in the ducts and glands communicating with this tract, or of the last stage in the sequence—viz., cancerous infection—since they must necessarily vary with the prominence of the particular end result. The amount and degree of pain depend upon the character and locality of the obstruction, as does also the degree and extent of the flatulence. While the mechanical results of obstruction to the effluent in the drainage scheme are very important, they are trivial as compared to those brought about by the absorption of an abnormal amount of toxins into the circulation.

When these poisons or the products of their conversion exist in excess in the circulation they produce degenerative changes in every tissue and in every organ of the body. It is probable that the textures of those organs whose business it is to convert, carry, or eliminate them suffer more than do the other tissues of the body which are merely permeated by them. In proportion as the stasis is prolonged, so under the influence of a progressive strain greater than they are able to bear these several organs undergo a degeneration which proceeds with increasing rapidity as the condition advances. What the organs are which convert and excrete these poisons, what share each takes in the process, and how any organ is affected in its physiology are very difficult to define accurately, especially as far as the ductless glands are concerned. We believe that the liver is the most important converter of these poisons, and that the kidneys and skin are the chief excretors of the products of conversion.

As to the part taken by the thyroid gland, the pituitary body, and the suprarenals, we possess little precise information. Our observations in this direction are purely experimental, and if our several operations on the drainage scheme have done nothing more than demonstrate the damage done by these poisons, the remarkable power of repair which the several tissues of the body exhibit on being freed from their malign influence, and the extraordinary improvement in the functioning of the organs of the body after operation, they have

been fully justified. They have, however, done more than this, since they have thrown a light on intestinal conditions which has simplified their treatment most materially, and has put them upon a definite mechanical basis, replacing what was little more than a nomenclature.

As corroborating the wisdom of attending to the drainage scheme of our bodies I would call your careful attention to some of Dr. Carrel's experiments, since they throw a most important and instructive light on the subject. When I saw Carrel more than two years ago he showed me living tissues growing in a sterile medium on a microscopical slide. At that date they had been growing for twelve days. I asked him what would result from the defective drainage of the tissues, since the quantity of serum was limited and the products of growth must be ejected into it. He said he did not know, but expected to learn shortly. After a few days he found that the vitality of the tissues became diminished, and that the growth of the cells was slowed and that it ceased very soon after. Death of the tissue took place obviously because of the imperfect drainage, just as our bodies and tissues become depreciated and finally die from chronic intestinal stasis. To meet this when growth commenced to flag, he opened up the specimens of growing tissue and washed away the toxic products, and by so doing he gave the material another period of growth extending over about fourteen days. This he was able to repeat many times before death finally took place. A line indicating the extent of growth was for a time level, then descended gradually, and finally very rapidly, illustrating exactly what takes place in chronic intestinal stasis in the human subject. By attending more carefully to the drainage of the toxic products of his specimens he was able to carry the growth along a horizontal line with regular undulations. Again, by feeding them with the juice of fœtal thryoid or spleen, he increased the growth of these tissues in an extraordinary manner, the increase during twenty-four hours varying between three and forty times the bulk of the original material. In this way he replaced the gradually descending line, representing the tissue growth ending in death, by one which is rapidly ascending, and shows no indication whatever of termination in death of the tissue. In other words, by attending carefully to the drainage and by giving suitable foods he gave that tissue a perpetual life and a rate of growth enormously in excess of the normal. He proved in an indisputable manner that decay is due to an inability of the tissues to eliminate waste products. Carrel's observations are of the greatest service at the

present moment since they afford us the same confidence in our method of treatment that X-rays did in the case of operation for simple fracture when the opposition to that form of treatment was intense, and to a great extent unscrupulous in its method. I am relating this to show how very simple and yet how very important is the problem involved in the consideration of chronic intestinal stasis. I have recently seen him perform the same experiment on a larger scale. He eviscerated a cat and so arranged the drainage of the intestine that it continued to perform its function normally during artificial respiration for a period of about ten hours. He hopes by preventing the death of the organs by peritonitis to prolong their life for a much longer period. The improvement in the growth of tissue which he obtains by attending very carefully to the drainage is well illustrated in the great and very rapid increase in the growth and weight of the child suffering from tubercle or rheumatoid arthritis which takes place after the large bowel has been excluded from the gastro-intestinal tract.

I cannot illustrate more dramatically the condition of excessive growth following on improved drainage than by describing a case of rheumatoid arthritis in a young girl. Her colon was disconnected from the gastro-intestinal tract by an ileo-colostomy below the last kink.

A female, aged 10½, a helpless cripple suffering from rapidly progressive rheumatoid arthritis in spite of careful and constant treatment. She was short-circuited in November, 1911. This chart shows her weight before the operation to be 49 lb. She lost 2½ lb. during the fortnight following the operation, her weight on November 13 being 46½ lb. On October 1, 1912, thirteen months after the operation, her weight was 87 lb., so that between November 13, 1911, and December 24, 1912, her weight had increased by 40½ lb., or in other words, in thirteen months she had nearly doubled her original weight. On consulting Dr. Still's work on "The Common Disorders and Diseases of Childhood," he puts the normal increase in weight at this age at 6 lb. in twelve months. This shows that the improvement in her drainage scheme had produced an increase of more than six times the normal. Besides this abnormal increase in the growth of the child her disease was stopped abruptly and she is now a vigorous, active and healthy child. She has been shown to the Medical Society by Mr. Barrington Ward, who described her case (*see* fig. 49).

The magnificent work that Carrel has done in the Rockefeller Institute has confirmed my views on the importance of chronic intes-

tinal stasis in the most complete manner possible. The results of his experiments on the growth of tissues are perfectly obvious and indisputable. In reference to this I here quote a few lines from the *Scientific American*, October 26, 1912, on "The Immortality of Tissues," by Genevieve Grandcourt: "It has now become evident that, under the right circumstances, the artificial growth of tissues can be utilized in the study of many problems, such as malignant

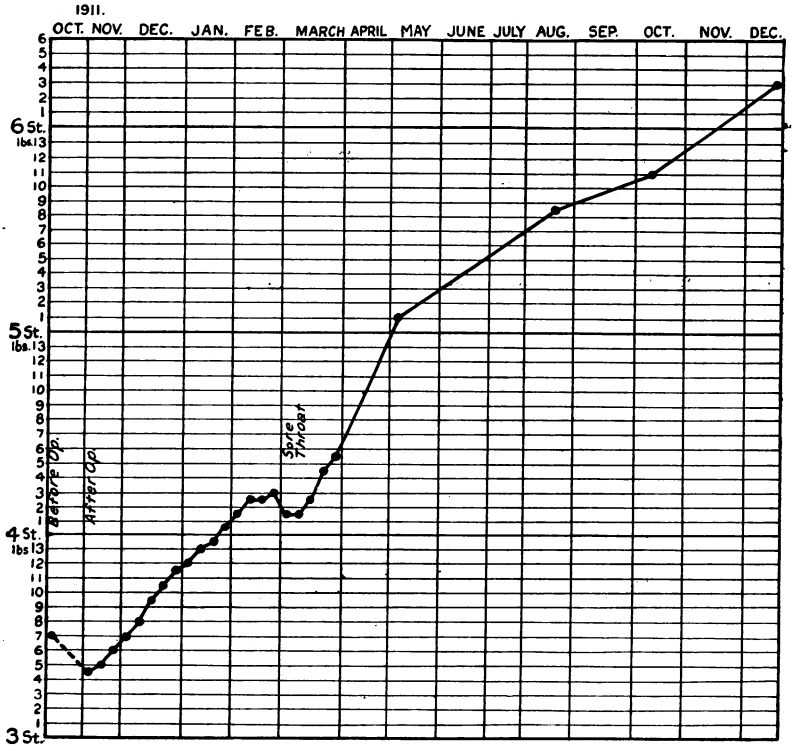


FIG. 49.

growth of tissue, certain problems in immunity, as, for example, the production of antibodies and antitoxins of certain organisms; the re-integration of tissues, the regulation of the growth of the organism; rejuvenation and senility, and the character of the internal secretions of the glands, such as the thryoid, which plays a rôle most important in physical and mental development."

The questions to which Carrel will apply himself to investigate by these methods will certainly modify our views on the treatment of disease very greatly.

Professor Arthur Keith has done a great deal of original work on the functions of the large bowel. The following quotation from a lecture delivered at the Royal College of Surgeons and published in the *British Medical Journal*, December 7, 1912,[1] has an important bearing here. The title of the paper is "The Functional Nature of the Cæcum and Appendix":—

> Every year the opinion gains ground that the great bowel, from appendix to rectum, has become, so far as man is concerned, a useless and dangerous structure. Exactly ten years ago (October, 1902) Dr. Barclay Smith, of Cambridge, gave a clear expression of this new conception.
>
> "If there is any truth," he wrote, "in the suggestions offered in this paper, they have an important practical application as regards the large intestine of man. From the nature of his diet a reliance on extrinsic digestive aid as is furnished by bacteria is no longer a physiological necessity. The statement is perhaps a bold one, but I am convinced that the large intestine is practically a useless encumbrance to him."
>
> In the following year (1903) appeared Metchnikoff's famous book on "The Nature of Man." In that work (p. 69) the new conception received a more decisive statement:—
>
> "It is no longer rash to say that not only the rudimentary appendix and the cæcum, but the whole of the large intestine are superfluous, and that their removal would be attended with happy results."
>
> Before either of these statements had been made, Mr. Arbuthnot Lane had reached the conclusion that the human cæcum and the ascending colon served, in a certain class of cases described by him, as a "cesspool," and put his new conception into practice either by excluding the great intestine from the digestive tract by "short-circuiting," or, at a later date, by its complete excision. The result of his operations shows (1) that life is possible without a great intestine; (2) that in certain cases the conditions of life are improved. It is very apparent that Mr. Lane's pioneer operative measures are finding every year an increasingly wide application, and that the views of Metchnikoff and of Barclay Smith are gaining in acceptation amongst medical men.

I will now consider the effect on the several organs and tissues of the body of an excess of toxins or poisonous products in the circulation. Perhaps the most conspicuous result is the removal of fat. This brings about not only an appearance of premature senility, but also a series of changes of infinite importance to the individual, and especially to the female, in whom, for reasons I have already indicated, fat plays a far larger share in supporting important organs and structures than it does in the male. The changes in the position of the several organs which follow on the loss of fat serve to exaggerate

[1] *Brit. Med. Journ.*, 1912, ii, p. 1599.

the existing stasis in the gastro-intestinal tract and to produce a vicious circle. The removal of the pelvic fat results usually in a backward displacement of the fundus of the uterus, which rests upon the concavity of the rectum. When the woman strains to evacuate the contents of the rectum she drives the large gorged fundus vertically downwards and the rectal lumen is compressed between it and the sacrum, or the uterus may be bent forwards, partly on account of the loss of fat and to a large extent because of the degeneration of its muscular wall which exists generally throughout the body. Consequent on the engorgement and the displacement or kinking of the uterus, a number of changes take place in that organ which call for the attention of the gynæcologist. As we shall see, auto-intoxication plays so large a part in the development of diseases of the female genito-urinary apparatus that the gynæcologist may also be regarded as a product of intestinal stasis. If women were not imperfectly drained the gynæcologist would not have been evolved. The removal of fat from the true pelvis permits of the greater descent of the cæcum and small intestines into that cavity and exaggerates the obstruction of the ileal effluent correspondingly. The kidneys move freely in the space behind the peritoneum in which they were originally supported by a cushion of fat and changes ensue in these organs should the escape of blood or urine from them be controlled by their altered relationship to adjacent structures.

As regards the attractiveness of the woman, a matter of vital importance to her happiness, the loss of fat is a most serious factor. The formation of wrinkles, the prominence of bones, &c., are all most distressing and conspicuous features. The buttocks also become flat and flaccid, instead of firm and round, partly because of the disappearance of fat which enters so largely into their formation and partly because of the associated degeneration of the large gluteal muscles. The breasts also waste and flop downwards, and the whole form and contour of the woman alters conspicuously in the most objectionable manner. The skin undergoes remarkable changes. It becomes thin, inelastic, sticky, and pigmented, especially where it is exposed to any pressure or friction. This pigmentation is observed first in the eyelids, whence it spreads gradually over the face. The neck becomes brown and later almost chocolate-coloured. The skin of the axillæ, abdomen, adjacent aspects of the thighs, and that covering the spinous processes of the vertebræ, becomes progressively darker and darker, and defined areas of even darker pigmentation may develop

on these stained surfaces. The secretion from the flexures also becomes abundant and offensive. In some of the cases I have operated on this symptom has been such a marked feature as to render the patient very objectionable to others.

Here I would like to call attention to the extraordinary variation in the resisting power of the individual as manifested by the colour of the hair, not only to the changes in the fat and colour of the skin already referred to, but to all other consequences of auto-intoxication. The darker the hair the lower is the resisting power to auto-intoxication and the more conspicuous are the changes which result from it. On the other hand, if the hair is red or of a peculiar towy colour the individual has a maximum of resisting power to the action of these poisons, and that resisting power varies directly with the distribution and with the intensity of the redness of the hair. This is manifested very conspicuously in the influence exerted by the toxins on the appetites of the individual. The darker-haired subject will loathe the sight of food and frequently abhor any sexual relationship, while the red-haired subject rarely manifests these effects, even in the extreme conditions of intestinal stasis. This influence of toxins on the normal appetite is of far-reaching importance in our present state of civilization and is the source of much misery, discontent, and trouble, to which I will not do more than allude here.

Some time ago I called attention to the influence prostatic secretion exerts in combating the effects of auto-intoxication. I pointed this out to Metchnikoff, who thoroughly agreed with me on the subject, and afforded me additional confirmation of its truth by the results of experiments on the action of prostatic fluid upon spermatozoa. To attempt to meet this condition Messrs. Armour make in their works in Chicago "tabloids" of extract obtained from the prostates of rams, and these have been administered very generally and apparently with marked benefit.

Other changes in the skin are those dependent on a damping down of the heart's muscle by the toxins, and upon a breaking up of the red corpuscles, which is called in the most marked condition "microbic cyanosis." The limbs become very cold and this coldness becomes exaggerated as the extremities are approached. If the hand be passed over the shoulder it crosses abruptly from an area of warmth to one of comparative coldness. This corresponds to a line drawn transversely round the centre of the deltoid. The skin of the back of the upper arm is very thick and feels as if it were affected by a firm, brawny œdema. Its colour is bluish, and in some cases even livid. It is liable

to be covered with hard, pointed papules. This condition exists to a much more marked degree in the girl than in the woman, and may be sufficiently conspicuous to render the wearing of short sleeves impossible. The skin of the forearm and hand is mottled, being bluish and yellow in patches, while the fingers may be quite blue or cyanotic. The legs present the same condition and usually in a greater degree. The patient frequently complains that she has no feeling up to her knees even in moderately warm weather. These people are better in warm weather and in fairly high altitudes, and are always worse in the cold, and by the sea. In some cases the condition was so marked as to have been called Raynaud's disease by experienced observers.

The muscular system degenerates in a very marked manner. The muscles waste and become soft, and in advanced cases tear with the greatest facility. In consequence the individual assumes positions of rest. In young life the muscular debility produces the deformities which are called dorsal excurvation or round shoulders, but which are more scientifically described as the "symmetrical posture of rest of the trunk," lateral curvature or scoliosis, which is better designated as the "asymmetrical posture of rest of the trunk," flat-foot, and knock-knee. These conditions are still further exaggerated by pressure changes in the epiphyseal lines. To subject these cases to exercises or to fix them in apparatus without also removing the primary factor in their causation—namely, auto-intoxication—is of little service.

The relaxation of the muscle wall of the abdomen deprives it of its function of compressing the viscera efficiently in defæcation and results in the accumulation of fæcal matter in the pelvic colon. This elongates proportionately and renders the evacuation of its contents more and more difficult. The abdominal muscles cease to exert upon the several viscera that firm pressure which is requisite to keep them in their normal relationship to the spine and to each other, and the errors in drainage become further accentuated. The normal mechanical disadvantages of the female abdomen render these changes much more conspicuous than in the male subject. As I have already pointed out, the uterus suffers in the same manner, so that it flops or bends about in response to gravity and intra-abdominal pressure, and much trouble in it and in other structures ensues in consequence.

The muscular wall of the intestine wastes in a similar manner, so that in an advanced case of stasis the ileal wall is very thin and bluish or livid in colour, resembling the appearances seen at a post-mortem, and they give out a distinctly earthy or fæcal odour. The

intestine has no rounded form, but being inelastic puddles like jelly in the floor of the true pelvis, forming innumerable bends through which its contents are transmitted with great difficulty.

The heart-muscle is influenced by the poison in the same manner. Here, however, we get two distinct conditions arising, varying, I believe, with complications in the most important excretory organ—the kidney, as well as in the circulatory system itself. In one group of cases the heart is soft, flabby, and the blood-pressure subnormal; while in the other the left heart is definitely enlarged, the aorta dilated and its walls atheromatous, as are those of all the vessels, and the blood-pressure is abnormally high. I am greatly indebted to Dr. Jordan for demonstrating most clearly to me the changes in the heart and aorta in this class of case. Generally speaking, the soft heart and low blood-pressure are more common in the female subject, while the enlarged heart and high blood-pressure are more frequently observed in the male. Inflammatory or degenerative changes in the kidney are much more commonly associated with the second group than with the first.

If, unfortunately, the patient is the subject of syphilis, the combination of this disease with auto-intoxication produces an extreme degree of change in the wall of the large vessels, and especially in those of the trunk.

Dr. James Mackenzie has recognized and described the heart changes consequent on auto-intoxication so thoroughly in his work on the subject that any further reference to them by me is unnecessary. I would merely add that the normal degree of blood-pressure is soon restored to the patient when the large bowel is excluded by operation.

The toxins appear to exert a special depreciating influence upon the respiratory centre. How far this is produced in the nervous centre, and how far it results from a degeneration of the respiratory muscles, is very difficult to determine. Dr. Vaughan and Miss Wheeler[1] assert that proteids can be split into a poisonous and non-poisonous portion, and they are of opinion that the deleterious component is a respiratory poison. It can produce acute, subacute, or chronic poisoning, depending on the manner and the rate of its introduction into the body.

The toxins exert upon the nervous system a most distressing and depressing effect. This is perhaps the worst feature of the effects of chronic intestinal stasis. The patient is usually miserable. Sometimes

[1] "The Effects of Egg-white and its Split Products on Animals," *Journ. of Infect. Dis.*, Chicago, 1907, iv, pp. 476-508.

the depression and misery is so great as to constitute melancholia, or imbecility. Several of my patients have contemplated suicide and have used the intention to do so to induce me to operate on them. Headache, varying in character, is very frequent. It may be a dull ache that appears on awakening, or it may be an intense headache accompanied with vomiting. I removed the large bowel in a patient who had been regarded as insane by some medical men and in whom one of our ablest brain specialists diagnosed a tumour in the frontal lobe and urged operation. This was fortunately refused by the patient. This headache disappeared at once when the large bowel was excluded from the drainage scheme.

I had under my care a girl who had been confined to bed for months. She was unable to stand, and was so stupid that she appeared to be an imbecile. The removal of the large bowel was followed by a very rapid and complete return to health. She is now perfectly intelligent and is earning her living. Another case of epileptiform tic of the right fifth nerve which had existed for eight years and which had rendered the patient's life unendurable, was cured by excluding the large bowel. These represent the more serious types of headache, neuralgia, or neuritis, but lesser degrees are extremely common in these patients and are cured by removing the auto-intoxication which would appear to produce them.

The favourite term for these cases of auto-intoxication in which the nervous system suffers in a marked manner is neurasthenia. They used to be treated by rest in the supine position, massage, and feeding. By all these means the effluent from the ileum was improved and fat was put on. The patient derived a fleeting or more or less permanent benefit from the treatment, which varied with the extent of the infection of the dammed-back contents of the ileum. Toxic patients sleep badly and have unpleasant dreams, or they may sleep very soundly all through the night and frequently fall asleep at any time of the day. They usually awake feeling miserable and unrefreshed by their sleep.

The breast behaves in a characteristic manner in auto-intoxication, so much so that it may be regarded as the barometer of the degree of poisoning. It presents at first induration, which commences in the upper and outer zone of the left breast, extending subsequently to the entire organ on both sides. Cystic or other degenerative change may ensue, and at a later period cancer appears with remarkable frequency in these damaged organs. I have found as many as seven distinct nodules of cancer in a hard, lumpy breast in which the presence of that disease

was not suspected. One of the most remarkable results of removing the source of auto-intoxication is the rapidity with which even extreme degrees of degeneration of the breast disappear, and the organ regains its normal form and texture after operation.

Perhaps the organ which surprised me most by its behaviour was the thyroid, for though I had long recognized the dependence of breast conditions on stasis I had obtained no certain evidence that the several changes that the thyroid undergoes were produced by it also. I had short-circuited patients who were clearly exophthalmic, or who had been so most distinctly at an antecedent period and were improving, and had not been altogether surprised at the rapid and complete disappearance of their symptoms, as one knows they may occasionally subside, or even disappear, as it is called, spontaneously. A patient was admitted under my care with marked stasis who had been driven to resort to operation by abdominal pain and vomiting, and by the associated mental and physical misery and depreciation. For eight years she had suffered from an enlarged thyroid which projected forwards in her neck and which interfered with respiration. It contained several large adenomata. As the anæsthetist hesitated to administer an anæsthetic for resection of the large bowel because of the goitre, I urged her to consent to the removal of part of her thyroid in the first instance. This she fortunately refused to submit to, saying she would have her bowel removed or go out of the hospital. Consequently this was done without any serious cause for anxiety. Within a few days of the operation it was obvious that the thyroid was diminishing steadily in size, and this diminution continued till when she left the hospital it was but little larger than normal. I understand that at the present time it is not larger than normal. When this was related to Metchnikoff, he exclaimed, "C'est un cas qui coûte," and his rapid grasp of the importance of this result has been fully borne out by subsequent operations on similar cases accompanied or not by exophthalmic symptoms.

Another most important consequence of auto-intoxication is the lowering of the resisting power of the tissues to the entry of organisms. There are organisms which exist in large quantities in our drainage scheme, and which are only able to secure a foothold in our tissues when their capacity to deal with these organisms has been reduced. By far the most common cause of this lowered resisting power is auto-intoxication, resulting from intestinal stasis. One sees that from the earliest period. The resisting power of the mucous membrane being lowered allows of its infection by organisms which extend or involve the

lymphatic tissue in the nasopharynx, producing adenoids and large tonsils, and later changes in the ear and nasal sinuses. These secondary manifestations of stasis produce cumulative symptoms and add their share to the depreciation of the vitality of the tissues.

In these toxic people the organisms which exist normally in the mouth are able to secure a foothold in the interval between the teeth and gums and manifest their presence as an infective or inflammatory process. This extends deeper and deeper into the socket and results in the loss of the affected teeth. This process usually commences, as one would expect it to do, about the lower incisors. As a quantity of organisms is grown in these nurseries the absorption of their products into the circulation, gastro-intestinal tract, and respiratory apparatus all assist in the general process of depreciation. Many observers are inclined to regard these secondary foci as primary, since a marked improvement in the general resisting power may result from their effective treatment. A little consideration shows the absurdity of this supposition. In a considerable proportion of the patients who are driven to operation by the results of intestinal stasis, all, or almost all, the teeth have been previously removed for this reason. The removal of the teeth has not relieved the symptoms of the stasis, which was the primary factor. Again, however bad the condition of infection of the gums may be at the time of short-circuiting, an immediate and extraordinary improvement in this disease follows on the cleaning up of the small intestine.

In women who are toxic the infection of the genital tract is an extremely common and distressing feature. It manifests itself usually as an infection of the mucous membrane or the muscle of the uterus, and is called endometritis or metritis. The continued presence of this infection brings about many troublesome consequences, the last link in the chain being here, as elsewhere in the body, cancer. It is the last chapter in the three-volume story of "Chronic Intestinal Stasis." The bladder of the toxic woman is also very often infected by organisms. Fortunately, the extension of organisms from the bladder to the kidneys is not as frequent as one would expect, yet it is quite common enough to produce much disease of these organs. The urinary apparatus in the male is also affected, especially in early life.

I do not think I need call the attention of the obstetricians to the important part played by pregnancy in relieving the disabilities of the drainage scheme. The ascent of the uterus in the abdomen serves to raise the portions of the drainage scheme which have

prolapsed, to tend to stretch retaining bands, and to improve materially the effluent from the ileum, &c. Consequent on this the woman puts on fat, and pillows up the several organs, and tends to obviate their subsequent prolapse. It is in this manner that a toxic, thin, miserable girl may be converted into a plump, clean, happy one by a pregnancy.

Perhaps one of the most interesting efforts of Nature to obtain similar advantages is by the formation of an ovarian tumour. This, as is true of all evolutionary processes, tends to benefit the individual in the first instance, but destroys her later by interfering with the functions of other organs. I have already shown how the bands or membrane forming the last kink secures the left ovary and causes it to become cystic. This forms another illustration of the third law I have referred to earlier in the paper.

The eye also shows very definite changes in auto-intoxication. The condition of the conjunctiva is very characteristic. The sclerotic appears dull and opaque and lacking in brightness, and if the lid be depressed the reflection of the conjunctiva shows what appears to be a quantity of fluid in its texture. The cornea shows degenerative changes around its margin, and the lens and muscles of accommodation suffer in a degree corresponding to that of the stasis. I believe that many of the degenerative changes in the eye are due to auto-intoxication. All these conditions improve at once, and obviously, after the intestines have been cleaned and freed from stasis.

The hair of the head falls out, either because of impaired nutrition of the cells or from the invasion of the roots by organisms. In the young subject, associated with this there is a new growth of a fine down over the cheeks, lip, chin, down the back and over the forearms, all of which conditions are very disfiguring and very distressing to the sufferer. These all disappear, more or less completely, with an improvement in the drainage.

The joints of toxic people, and especially of children, are very loose, and permit of considerable over-extension. We know that the fit or security of a joint varies directly with the development of the muscles which control it, and the feebleness of the poisoned muscles readily accounts for the insecurity of the joints. The skin is very liable to invasion by organisms, which form pustules, &c.

There are many diseases which cannot attack a subject unless the vitality of the tissues have not been depreciated by auto-intoxication. There is no limit to the number of diseases in which stasis affords the chief, if not the entire, factor in their causation. I will confine myself

to three to illustrate this point, as they lend themselves so readily and so obviously to demonstration. They are tubercle, rheumatoid arthritis, and Still's disease. I do not believe it is possible for either of these diseases to obtain a foothold except in the presence of stasis. I would exclude the direct inoculation of tubercular organisms through a wound, but this is a very uncommon mode of infection.

In all our cases of these diseases we have carefully examined the condition of the patient clinically, both generally and by manipulation of the abdomen, for evidences of stasis, and we have confirmed this by bismuth meals and X-ray observations. We have been able to satisfy ourselves that in these diseases stasis, and the auto-intoxication consequent upon it, is a necessary antecedent factor in their development. We have also been able to demonstrate that the effectual drainage of the patient is followed by a complete cure of the condition, except in such cases of tubercle where infection other than that of tubercle is superadded. The degree of improvement which follows an operation on the drainage scheme in tuberculosis varies with the purity of the infection.

The rheumatoidal cases show the most abrupt and conspicuous change following within a few days, and in some cases even hours, an ileo-colostomy. I have seen patients who have been unable to move their joints for months or years acquire a free movement within four days of the operation. Even more rapid is the abrupt disappearance of pain. The striking and rapid and, to my mind, wonderful alteration that follows in rheumatoid arthritis is familiar to any surgeon who has performed this operation, or who has observed cases after operation. It is even more striking than the change in the temperature and feel of the extremities, the sudden disappearance of headache and misery, the change in the colour of the skin and in the nature of its secretion, the alteration in the texture and feel of the thyroid and breast, &c., since the structures which enter into the formation of a joint are much denser and less vascular, and one would expect them to be less liable to undergo rapid change. I will quote from the letter of a well-known and energetic surgeon the following details, since it affords an independent view of the condition:—

February 15, 1913.

Since I saw you operate I have operated on a poor woman concerning whom I was in despair until you showed me your cases in the hospital. A case of rheumatoid arthritis was in this hospital for weeks and weeks under a colleague. Deriving no benefit, she was sent to Droitwich and returned worse. Some three months ago she could scarcely crawl into the out-patient room because of the pain in her ankles. Hearing her history I

tried to see if I could find a source of poisoning in any region. Discovering much discharge from the uterus, and a very unhealthy os uteri, I curetted her and used the actual cautery to the os. Then I injected her with antistreptococcic serum. She was very ill for a time in consequence. Then she remained a chronic invalid with knees that would neither bend nor straighten. A bismuth meal showed marked stasis. I therefore performed your operation, and next morning she said: "I can move my legs anywhere without any pain in my knees." In fact, she eats and drinks all she can get, although the operation was only done a week ago.

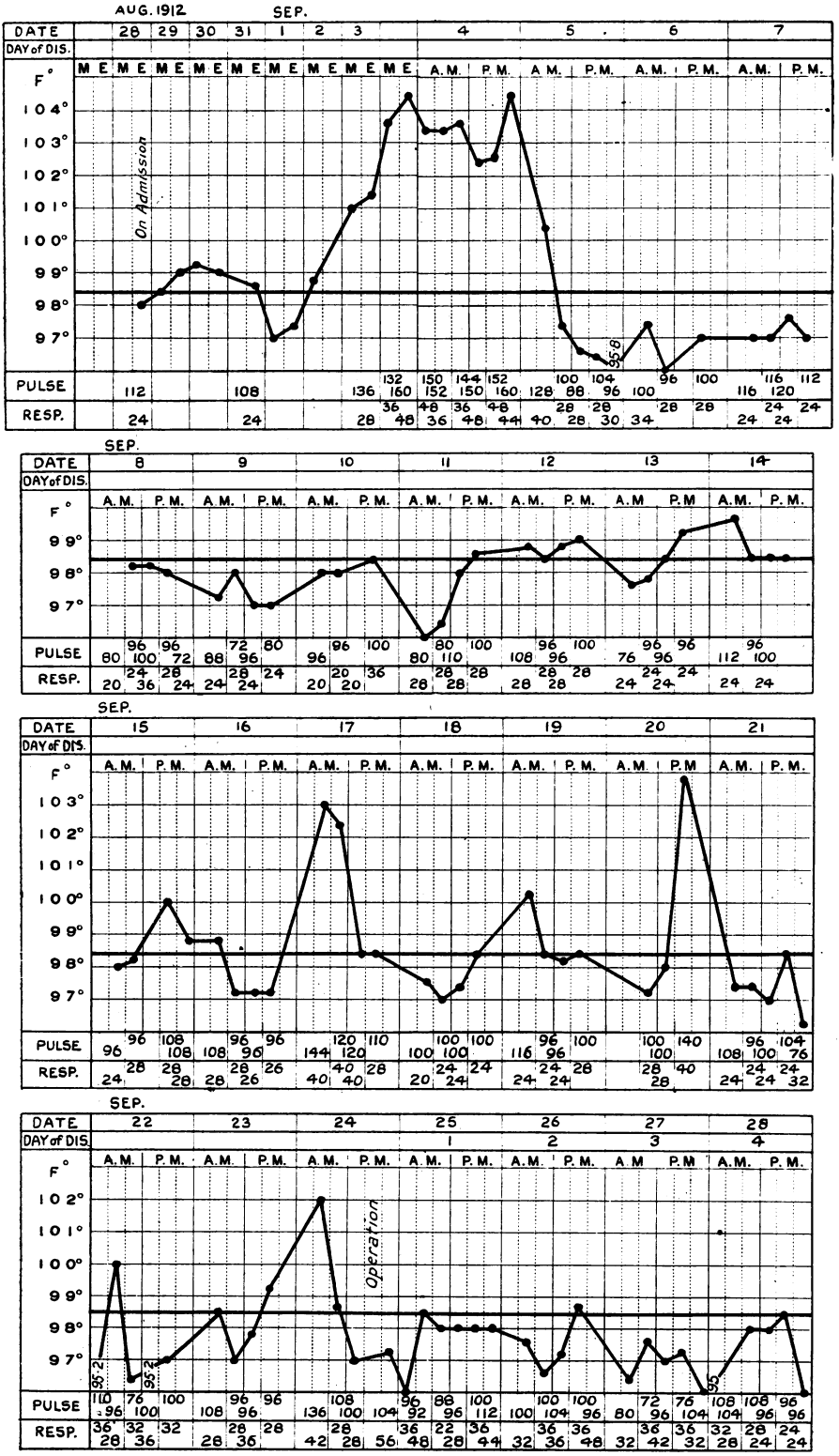
I could furnish you with the records of many cases of tubercle and rheumatoid arthritis, should you care for them. I would refer to cases published by Mr. Harold Chapple, Mr. Barrington Ward, and Mr. Schlesinger.

There are one or two points of interest in relation to abdominal tubercle which would appear to show that the observations of the physiologists as made upon animals do not give us a very correct idea of the possibilities in the human subject. In evidence of this the following report throws some light. I removed the large intestine of a girl affected with extreme stasis. This portion of the bowel was much ulcerated and it perforated at several points while it was being removed. She progressed perfectly for nearly four weeks, when a fistulous opening appeared in the middle line through which a portion and then all the contents of the bowel escaped. She was too feeble to make any further operation at the time advisable, so we fed her with very nutritious foods and watched her. She steadily but slowly increased in weight during the two years following on the operation. During this time she led an active life and met the discomfort of the fistulous opening by clever little dodges which she herself devised. We gave her bismuth and examined her tract and found that not more than 18 in. of jejunum were functioning. At the end of this time she wished the opening closed. We therefore opened the abdomen, confirmed the length of small intestine which had been sufficient to meet her daily requirements of energy and also to add to her weight, and we established continuity of her small intestine.

Having learnt what a small portion of the small intestine is requisite to carry on life, I have not hesitated to remove the large bowel in cases in which the glands of the small intestine were matted up with a large caseous mass, and I have had no reason to regret doing so. In tubercle of the abdomen more than elsewhere does rapid disappearance of the disease follow disconnexion of the large bowel by ileo-colostomy with or without colectomy.

I will relate briefly the details of a typical case of Still's disease in a boy, aged 6½, showing glandular and splenic changes, stiffness in the neck with painful and tender joints which showed no bony changes. There was fluid in the joints. He was unable to walk. He had been ill for two years, during which time he was treated at the Evelina Hospital. He was extremely wasted, and appeared to have an adherent pericardium. Dr. Still saw the case and confirmed the diagnosis, and approved of operative interference as offering him the only chance of recovery. The accompanying temperature chart (fig. 50) shows his condition from his admission on August 28, 1912, till the date of operation, September 24, 1912. Several rises of temperature took place with corresponding changes in the pulse and respiration. In these attacks the child was very ill, and his blood gave a pure culture of *Staphylococcus citreus*. He showed distinct clinical and X-ray evidence of chronic intestinal stasis. After the operation of short-circuiting the child had no subsequent rise of temperature. This fluctuated below normal till October 4 or 5, 1912, and then continued uninterruptedly at a normal level. At the operation the end of the ileum presented a well-marked ileal kink. The mesentery contained a great number of large glands. The pelvic colon was very long, a condition we have observed to be constantly present in tubercular and rheumatoidal affections in young life. A swab taken from the contents of the ileum gave a culture of *Staphylococcus citreus*. The general condition of the patient and the size and mobility of the joints improved rapidly almost immediately after the operation, and within a few weeks the child was able to play about the ward, where he remained till January 8, 1913. Since that date he has improved steadily, both as regards his joints and his general health.

I do not propose to consider in detail such complications of intestinal stasis as membranous and ulcerative colitis and other consequences of superadded infection of the large or small bowel, as we are very familiar with their symptoms. Nor do I intend to supplement the evidence I have put forward by skiagrams showing the results of the administration of bismuth meals, since that has been done so well by my colleague Dr. Jordan. I might point out that his great success is largely due to the fact that he has not been satisfied to diagnose, or in other words to guess at the condition of the patient's drainage scheme by an examination of X-ray results only, but has made a habit of being present at operations. By seeing the changes in the tract, he has been able to examine his own work critically, and by correlating these facts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SEP.
15 16 17 18 19 20 21
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FIG. 50.

to obtain better results. The reason why so many fail in what is euphoniously called diagnosis is that they rarely see the inside of a living patient's abdomen.

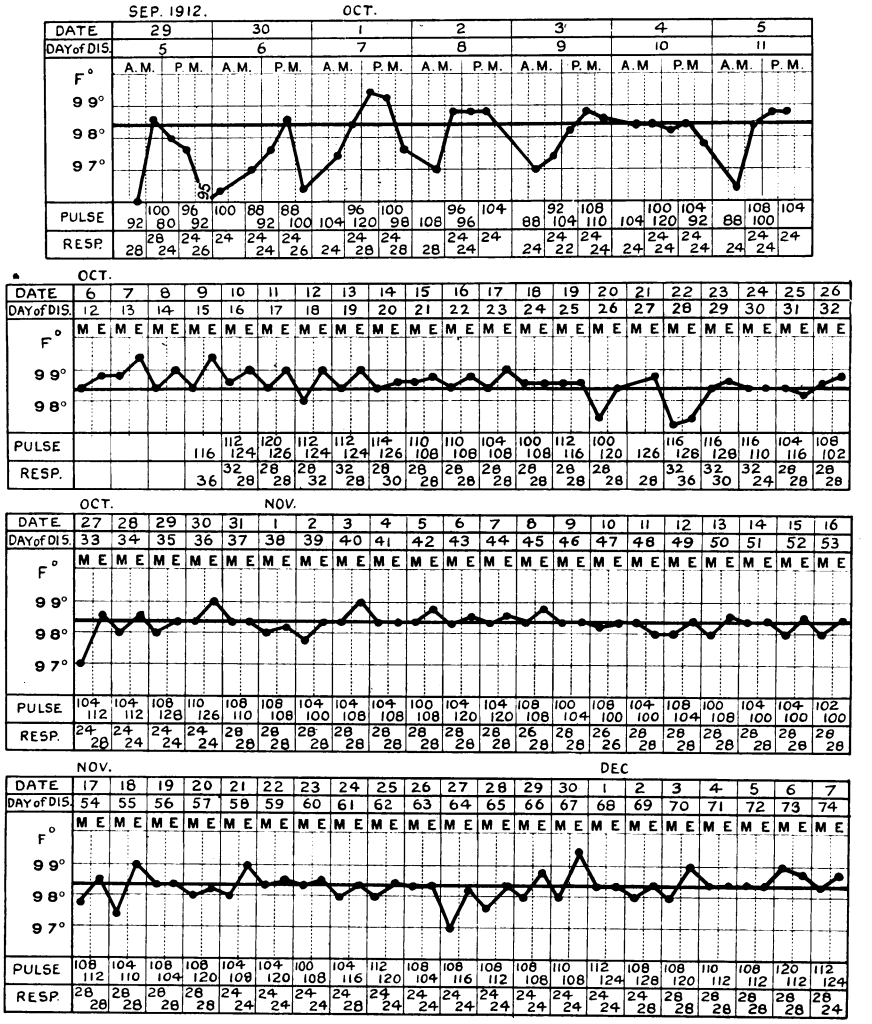

FIG. 50 (*continued*).

I take it that before submitting a patient to any surgical risk whatever it is our duty to employ every scientific means at our disposal to determine exactly what is wrong, remembering that a so-called exploratory operation on the intestinal tract is of little value, since it is performed on a drainage scheme which has been previously thoroughly

emptied of its contents by means of powerful purgative drugs and enemata. That is the reason why an exploratory operation only too often ends in the removal of an anchored appendix, a result that appears to satisfy the ambition of the surgeon, and the curiosity of the patient and the friends. I trust that this phase of surgery is rapidly passing away, together with the obscurity that was associated with the medical treatment of the results of chronic intestinal stasis.

From the surgeon's point of view, the treatment of chronic intestinal stasis consists in facilitating the passage of material through the several portions of the gastro-intestinal tract, and so obviating the mechanical and chemical results of any fault or faults which may develop along its length consequent on the peculiar mechanical relationship of the individual to surroundings as involved in the complex conditions of the civilization of the present day. In the vast majority of cases the use of a lubricating material such as pure paraffin, which precedes the passage of food, application of some spring support to the lower abdomen which tends to keep the viscera up, and to control the delay of material in the small intestines and cæcum, and the avoidance of the use of such proteid foods as poison the tissues if retained for an abnormally long time in the intestine, are sufficient for the purpose. When these methods fail, resort must be had to operative interference. The object of such operative treatment is usually to facilitate the effluent from the ileum, and so to remove at once from the area of the drainage scheme, from which toxins are chiefly absorbed, the filth which supplied them.

As I have pointed out, the measures to be undertaken to bring this about depend entirely on the nature of the mechanical conditions which produce the stasis, and also on the state of the patient at the time. For instance, where the ileal effluent is controlled by an appendix which is hitched up behind the termination of the small bowel, the removal of the constricting band frees the lumen of the small intestine and restores it to its normal function more or less completely. At the same time, if in consequence of the stasis there are present marked rheumatoidal changes or tubercular infection, the emptying of the contents of the altered and dilated small intestine into the cæcum may not result in such an effectual clearing of the small intestine as will afford the sufferer sufficient spare energy to destroy the disease. In these circumstances, the only effectual way of bringing this about is by dividing the small bowel and introducing its extremity into the pelvic colon.

The same applies with much greater force to the control of the ileal effluent by the acquired membrane which produces the ileal kink. This condition of obstruction is much more serious than that which is brought

about by the appendix, since it is very liable to recur whatever means are adopted to obviate its recurrence. Obviously, such a recurrence cannot arise in the case of the appendix. Also, for some reason or other, the free division of these bands and membranes occasionally results in the production of a peritonitis which may cause serious anxiety. Consequently, when the ileal kink is produced by any extensive arrangement of acquired bands, especially in the female subject, I prefer to short-circuit rather than merely divide the constricting bands. I believe that in many cases the risks of short-circuiting are less than those of division, while the possibility of recurrence by the re-formation of these bands is permanently removed. The necessity of following the same occupation which determined the obstruction originally in the case of the man makes such a procedure all the more advisable. The convalescence after the short-circuit is also much more satisfactory than that which follows the division of bands.

If tubercle, rheumatoid arthritis, or any advanced condition of auto-intoxication be present, there is to my mind no doubt whatever as to the value of short-circuiting the patient. The more I see of these cases and of the excellent and far-reaching results that follow on this procedure, the more inclined I am to adopt it, rather than to effect what is frequently an unsatisfactory and temporary compromise. I believe that the operation that I call short-circuiting, which consists in the introduction of the ileum directly into the upper part of the pelvic colon, has not succeeded so generally as one would wish because the details of the operation have been imperfectly carried out. I have known many complaints of pain and diarrhœa after such an operation. This unfavourable result is frequently due to the fact that the surgeon has been satisfied with establishing the anastomosis alone, and has not closed in the interval between the mesentery of the ileum and that of the pelvic colon. The intestines have fallen down behind the junction till the termination of the ileum has done so also. This has resulted in a permanent or recurring torsion of the end of the ileum on its own axis, producing a varying degree of obstruction of its lumen and consequent pain and diarrhœa, these being due to incontinence caused by over-distension of the bowel behind the obstruction. The chief disadvantage of short-circuiting is the occasional tendency which exists for the material which passes from the ileum into the pelvic colon, if not evacuated very shortly, to ascend into the iliac colon. This can be met in the large majority of cases by the fixation of the colon to the posterior abdominal wall at the pelvic brim by exaggerating the last kink, should this kink be not already efficient. If this is done effectually the

chances of material passing upwards into the large bowel are very much diminished. As I have already pointed out, one of the purposes of the formation of the last kink would appear to be to obviate the ascent of fæcal matter from the pelvic colon in normal conditions, should the contents not be evacuated at the proper time. The presence of a quantity of fæcal matter in the pelvic colon is inconvenient to the functioning of the other pelvic organs, so that if it is not expelled it is displaced upwards into a more commodious area for the time being. If the last kink be well developed this is obviated and the material continues to set up a reflex which leads to its being forcibly expelled. In a certain proportion of cases it is advisable to remove the large bowel also. This may be required by the ascent of fæcal matter after an ileo-colostomy, or it may be called for if the colon be much dilated, and especially if its mucous membrane has been chronically inflamed. In such a condition as is called Hirschsprung's disease, the removal of the large bowel is generally required and the distension of this portion of the intestine facilitates its removal. It is not easy to draw a sharp line between the cases of stasis in which it is advisable to do a short-circuiting only and those in which the large bowel may be removed as well with advantage. If the patient is wasted and the abdominal wall is loose and flaccid, especially if tubercle or rheumatoid arthritis or other result of stasis are present, I much prefer to remove the large bowel at the same time as I short-circuit, but if I feel I can save the patient any risk whatever by doing the operation in two stages, I prefer to do so.

The only risk of short-circuiting or removal of the large bowel which is associated with the operation itself is the formation of adhesions. Against this there are apparently no certain means of prevention. We have tried many things applied to the intestine and have fancied that we have obtained better results from the use of silk cloths soaked in paraffin than with any other application. We are still in great doubt as to whether the paraffin is of any use, but feel pretty sure that the best way to prevent the formation of adhesions is to avoid any unnecessary exposure of or damage to the intestines in the performance of the requisite manipulations and to be most careful in one's aseptic precautions. To me, the formation of adhesions and their subsequent behaviour is somewhat of a mystery, except in so far as I believe that they are due to sepsis in one form or another. If one could prevent the formation of adhesions the removal of the large bowel would involve no risk whatever to life. In the old subject who has had auto-intoxication for many years and also is feeble and wasted, there is a freedom from the development of adhesions which would appear to be

due to an acquired immunity of the peritoneum to the organisms which are probably responsible for their development. At one time we were much troubled by suppuration in the incision in the abdominal wall in advanced cases. This we attempted to meet, on the suggestion of Sir Almroth Wright, by the cultivation of organisms from the urine, if they were present in it, and by the injection of vaccines made from them. We obtained very little benefit in this way. However, by the use of hot compresses frequently applied we have reduced the frequency of suppuration in the wound to a minimum. It is probable that by these means the patient is protected by the products of organisms which exist in the blood or tissues and which collect in the wound.

The Consequences and Treatment of Alimentary Toxæmia from an Odontological Point of View.

By J. F. COLYER.

I PROPOSE to preface my remarks on the consequences and treatment of alimentary toxæmia from the dental point of view by a short reference to the two main sources of oral sepsis—namely, (*a*) caries, and (*b*) gingival disease leading to periodontal disease.

(*a*) Caries consists in the progressive destruction of the tooth substance eventually leading to the opening of the pulp cavity. A septic inflammation is set up in the pulp, and in time leads to a similar condition in the periodontal membrane about the apex of the tooth. The amount of oral sepsis arising directly from carious teeth is small compared with the sepsis from the conditions started by their presence. The effect of caries is to render the teeth themselves and their immediate neighbours functionless, with the result that stagnation areas are formed of food débris, micro-organisms, &c., and a marginal gingivitis is started. The sepsis arising in connexion with the latter is far more serious in its effects than that from the septic material present in the carious cavities.

(*b*) *Gingival disease leading to periodontal disease* is by far the most fruitful source of oral sepsis. The condition known as pyorrhœa alveolaris has long been recognized in medical literature. A considerable amount of misconception, however, exists as to this disease, and as the early recognition of the condition is important, I hope you will permit me to dwell for a few minutes upon its clinical aspects. The disease in the early stages is characterized by a slight thickening of the interdental papillæ due to damage from the accumulation of food débris, &c.,